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DETROIT

Construction Methods

McGraw-Hill Publishing Company, Inc.

April, 1935

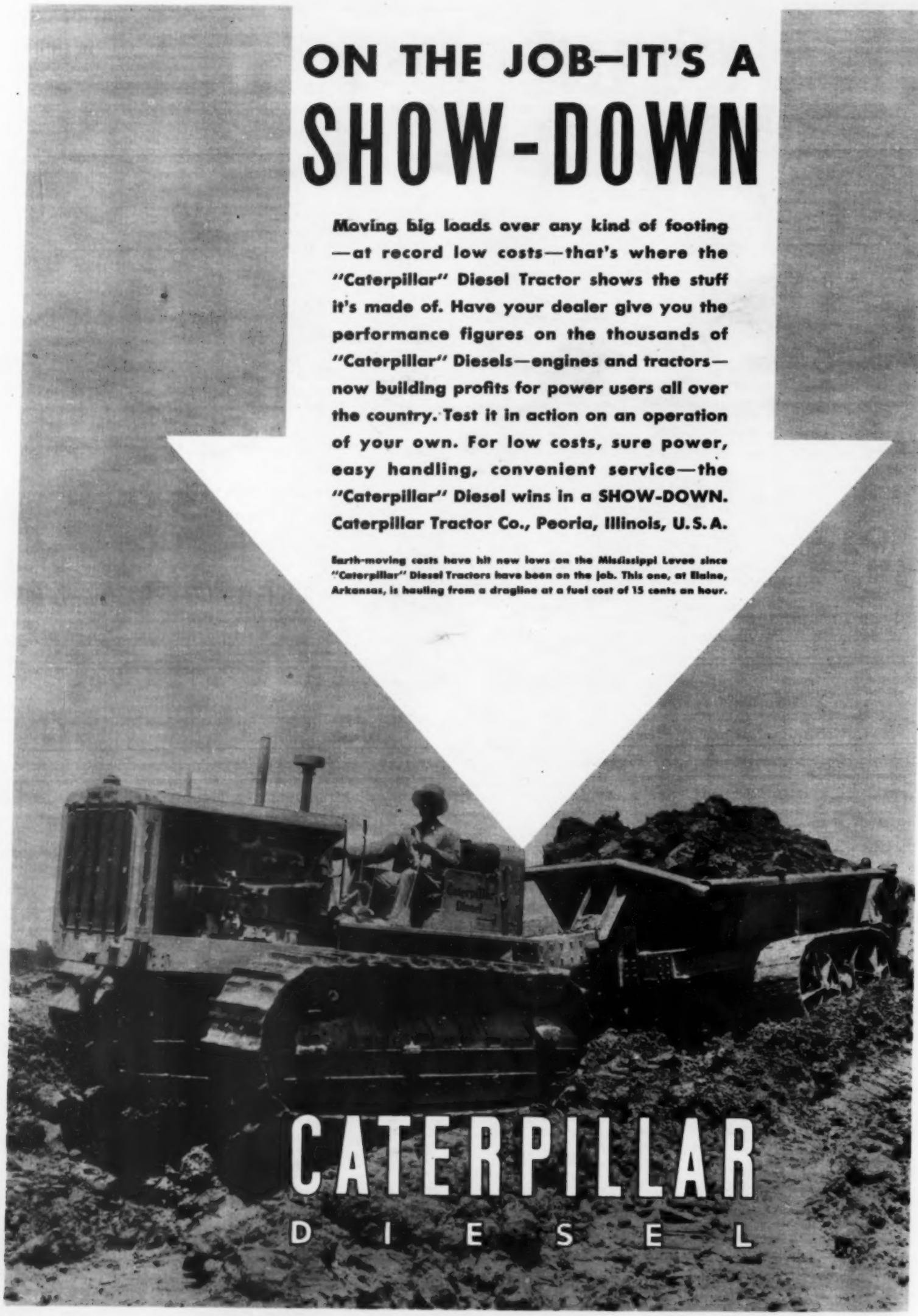
Price 20 Cents

HYDRAULIC GIANTS, formerly used for mining gold, make heavy cut for California state highway at Oregon Hill on Redding-Eureka route.

ON THE JOB—IT'S A SHOW-DOWN

Moving big loads over any kind of footing —at record low costs—that's where the "Caterpillar" Diesel Tractor shows the stuff it's made of. Have your dealer give you the performance figures on the thousands of "Caterpillar" Diesels—engines and tractors—now building profits for power users all over the country. Test it in action on an operation of your own. For low costs, sure power, easy handling, convenient service—the "Caterpillar" Diesel wins in a SHOW-DOWN. Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

Earth-moving costs have hit new lows on the Mississippi Levee since "Caterpillar" Diesel Tractors have been on the job. This one, at Elaine, Arkansas, is hauling from a dragline at a fuel cost of 15 cents an hour.



TECHNOLOGY DEPT.

Construction Methods

McGraw-Hill Publishing Company, Inc.,
330 West 42nd St., New York

ROBERT K. TOMLIN, Editor

APRIL, 1935

WILLARD CHEVALIER, Vice-President

Editorial Staff: Vincent B. Smith, N. A. Bowers (San Francisco)
Leonard H. Church (Cleveland), Nelle Fitzgerald

Kirby, in the Scripps-Howard Newspapers

Too Much Momentum to Stop

Public Works for Unemployment Relief

● Since plans for the $4,880,000,000 federal work-relief program were first announced a number of changes have been made that make the project, as amended, far more acceptable to the construction industry than was the original. For a while it was feared that the program might be executed by primitive wasteful day-labor methods, an inference drawn from the President's reference, in his message to Congress last January, to the use of "a large percentage of direct labor." No surer or speedier method of forcing the American contractor out of business could have been found than by adopting a general policy of day-labor for the Government's huge construction program. Happily, the day-labor threat was nullified when the bill was amended to provide that "wherever practicable, full advantage shall be taken of the facilities of private enterprise." This clause, carrying assurance of a policy of normal procedure in the award of contracts for projected work, gives to the construction industry the opportunity for rehabilitation so sorely needed.

Prevailing Wage Killed

● Another dangerous hurdle that was finally cleared in the legislative course of the project was the defeat of the McCarran prevailing-wage amendment. It will be recalled that when the broad plan for work relief was first presented it was recommended that compensation on emergency public projects should be larger than the amount received as a relief dole but not so large as to encourage the rejection of opportunities for private employment or the leaving of private employment to engage in government work. In the public mind at least, there is a very general misconception of the term "prevailing wage." It doesn't mean the wage that "prevails," in fact, in any locality; instead, as interpreted by public officials responsible for fixing wage rates and subject to political pressure by organized labor, it means an inflated union scale. Obviously, a general adoption of the "prevailing wage" scale, as it is usually interpreted in practice, for the vast work-relief program would have made a drastic cut in the number of jobs available for relieving unemployment and at the same time would have forced private, as distinguished from public, construction into an extended period of hibernation.

Under the policy of compensation as finally agreed upon, the President is authorized to fix the rates of wages to be paid on work-relief projects (except federal public buildings) and "may fix different rates for various types of work, which rates may not be uniform throughout the United States." Wage rates on buildings must comply with the Bacon-Davis act or appropriate code provisions. The compromise on compensation, however, contains the proviso that "if such rates are found, by investigation, to affect adversely prevailing rates of wages, the President shall fix rates at not less than prevailing rates."

Allocation of Funds

● The measure allocates to definite kinds of construction specific portions of the $4,880,000,000 appropriation, (of which $880,000,000 is for direct relief from unexpended balances of PWA and other funds). The quotas are: $800,000,000 for highways, roads, streets and grade crossing elimination; $500,000,000 for rural rehabilitation and relief in stricken agricultural areas; $100,000,000 for rural electrification; $450,000,000 for housing; $300,000,000 for projects for professional and clerical persons; $600,000,000 for the Civilian Conservation Corps; $900,000,000 for public projects of states or political subdivisions thereof; $350,000,000 for sanitation, prevention of soil erosion, reforestation, flood control and miscellaneous projects. Some readjustment of these allotments is provided for by granting the President authority to increase any item by 20 per cent of the $4,000,000,000, or by a maximum amount of $800,000,000. This latitude is so great as largely to deprive of any real significance the earmarking of funds in the bill, which was a contentious issue early in its consideration.

Supervision

● Present practice is specified for the allocation of highway funds among the states and the measure makes possible a program of highway construction on a larger scale than ever before. All but an insignificant portion of the $800,000,000 earmarked for road building will be used for the payment of work done under contract and supervised by the state highway departments and the U.S. Bureau of Public Roads.

Another feature of the administration of the program is the requirement that river and harbor projects, reclamation work and public buildings undertaken with funds from the $4,000,000,000 appropriation must be carried out under the direction of the regular government departments having jurisdiction over such projects.

The passage of the Emergency Relief Appropriation Act of 1935, as it is officially designated, assures the construction industry and the many other durable goods industries serving its needs for machinery and materials of a period of long-needed activity that should go far toward solving the critical problem of relieving unemployment.

Bright Prospects for Road Builders

● In the federal work-relief project the American Road Builders' Association sees assurance of a large and continuing program of highway, street paving and grade crossing elimination construction. The money available for highway construction under the Hayden-Cartwright bill and the new Emergency Relief Appropriation measure constitutes the largest federal and state highway appropriation of all time. The association's statisticians have computed for the years 1935 and 1936 a total of $1,462,000,000 from all sources, including both federal and state funds, available for road building.

Must Pay Workers for Job Delays

● Employees in coded industrial establishments must be paid for interruptions of work beyond their control when an employer requires them to be present and ready for work, under provisions of an administrative order issued by the National Industrial Recovery Board. The order lists four causes of interruptions to work over which, presumably, employees have no control. They are: Breakdowns, delays, time spent waiting for materials or waiting for the loading or unloading of railroad cars or other vehicles of transportation, and interruptions in activity due to other causes. The time during which an employee is inactive by reason of interruptions in his work beyond his control may not be construed as time not worked, nor excluded in computing his hours of labor and wages.

An Industry of New Methods

IN THE COURSE of the current hearing on Mr. Mellon's income tax, Frank B. Thompson, vice-president of the American Bridge Company, offered a comment that will strike a responsive chord with construction men everywhere. He was discussing the appraisal of the McClintic-Marshall Corporation and the matter of inventory was on the carpet.

> *"Inventory means nothing,"* said Mr. Thompson, *"because no two buildings in this city or hardly anywhere else are the same. Ours is a specialized, general contracting industry. You have to have the organization that has the ability to do things in new and novel ways on every job. Every competitor may be able to copy thereafter and you must find new methods."*

What Mr. Thompson has to say with respect to the fabrication and erection of steel structures applies to every department of the construction industry. It is essentially an industry of new methods. Every job is a fresh undertaking, usually awarded on the basis of an open competitive bid.

The methods employed on the last job always are an open book and the price the constructor must pay to land each job and to make a profit on it is that eternal resourcefulness which contrives newer, more suitable, more speedy and more efficient methods.

IN this unceasing process of improving practice for the more profitable performance of tomorrow the producer of construction materials and equipment obviously must play a vital part. For efficient construction depends not alone on the administrative and operating management but also on the workability of the materials and efficiency of the tools.

In this industry inventory truly means little. Not only is success a matter of new methods on every job; it is a matter also of the utmost coordination. The constructor cannot bring under one shelter the various jobs he may have in hand and build a wall about them, he cannot outguess the vagaries of the weather, he cannot standardize and supervise every motion of his employees. Rarely can he realize the close operating control that normally prevails in the manufacturing plant.

In no department of industry, therefore, is that intangible asset that we call 'morale', a more vital factor in the true worth of an enterprise. In no field are the qualities of self-reliance, resourcefulness and effective coordination more essential than in this one. Every successful construction organization must write down as its chief asset, far transcending in value its bank account or its physical equipment, this capacity for accomplishment. That is one reason why the nation would incur so devastating a loss if it were to embark upon a wholesale program of day-labor construction that might result in the disintegration of thousands of existing construction organizations. Their aggregate capacity for accomplishment constitutes one of the major national assets.

INCIDENTALLY, here is a commentary on the "share-the-wealth" fallacy now being sold to gullible citizens. The most essential elements of the national wealth, from their very nature, just cannot be shared on any arbitrary basis; any effort to do that must destroy them.

The essence of wealth is its productivity, i.e., its ability to produce those commodities and services that make for better living. And this capacity for production depends far more on these intangible factors of experience, resourcefulness and management than on any physical property that might be arbitrarily divided up and distributed. Its very integrity is of the essence of its worth; any attempt to divide it but destroys it.

What our "share-the-wealth" friends really should worry about is the most effective distribution of the *income* from our wealth. But that again invades the realm of human aspirations and incentives. There again we must deal with the motive power of human enterprise rather than its structural framework.

Suffice it that no reorganization of the state or of industry can produce more wealth or effect a more equitable distribution of wealth if in the process it impairs that incentive of human ambition which alone constitutes the motive power of progress.

But all that is another story. Here this writer would but subscribe to Mr. Thompson's testimony that the essential asset of any construction organization is its resourcefulness in contriving new and novel methods for the conduct of its work. And to just that proposition this journal has been dedicated.

Willard Chevalier

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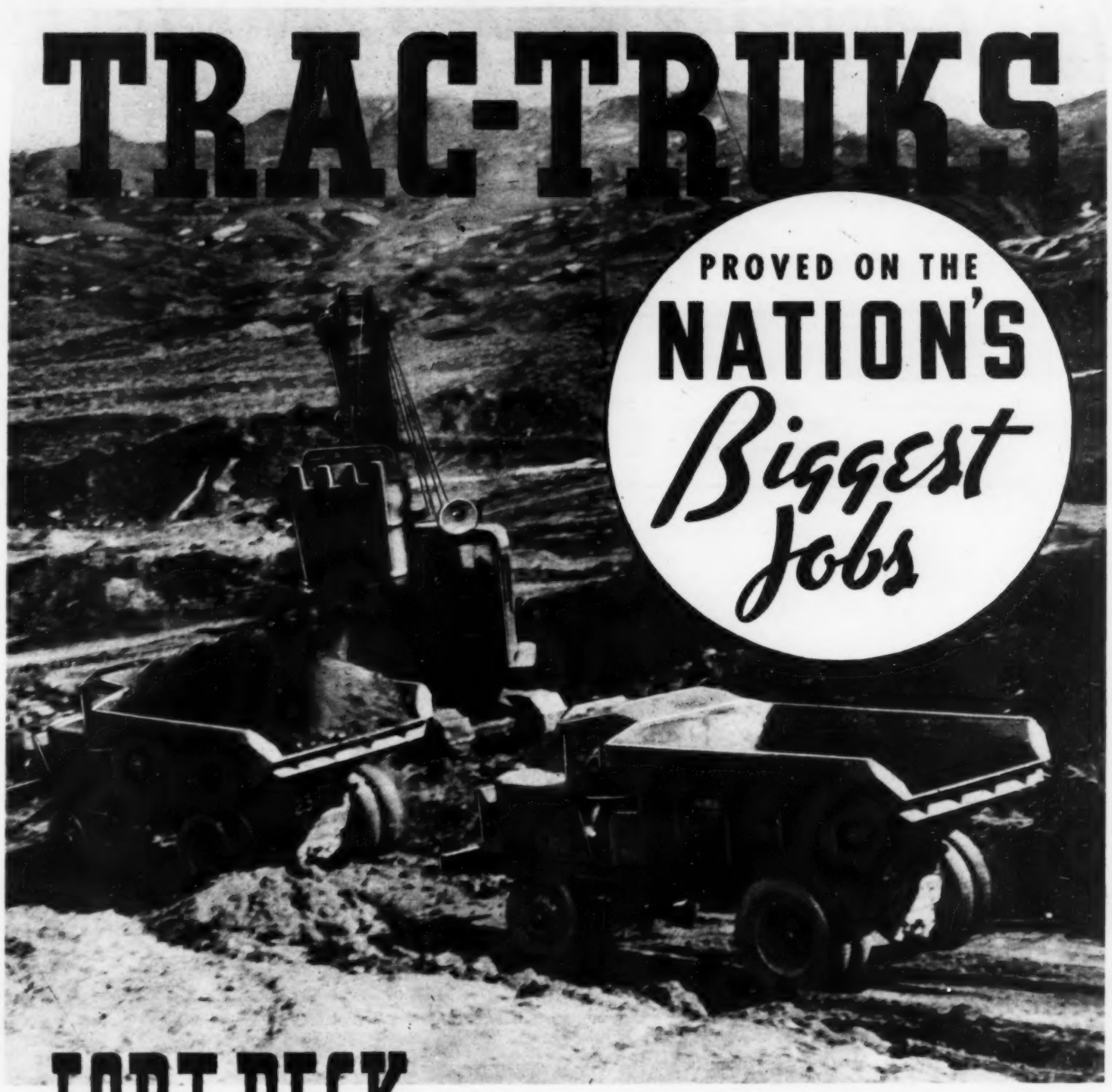
TRAC-TRUKS



FORT PECK

is again the point of operation for another large fleet of Trac-Truks. This time it is the Rear Dump Model—eleven of them—put into action when Martin Wunderlich struck "Bear Paw" shale on his spillway contract. They team up with the other eleven Bottom Dump Trac-Truks already proving their excellent efficiency in moving dirt on this same job. No more need be said about this operator standardizing on Trac-Truks for his hauling requirements.

This contractor is equipped to change quickly from duals to all-weather treads by installing *tire tracks*—an exclusive Euclid feature. Other advantages include sturdy construction—big load capacity—and concentrated power in the double reduction axle with planetary final drive.

● Trac-Truks are available in both the Bottom Dump and Rear Dump Models that cover the entire range of contractors' requirements for hauling dirt and rock materials. Write for new eight-page descriptive folder sent without obligation.

THE PIONEER

THE EUCLID ROAD MACHINERY CO. CLEVELAND, OHIO

Experience of Users...
...the Best Test of Dependability

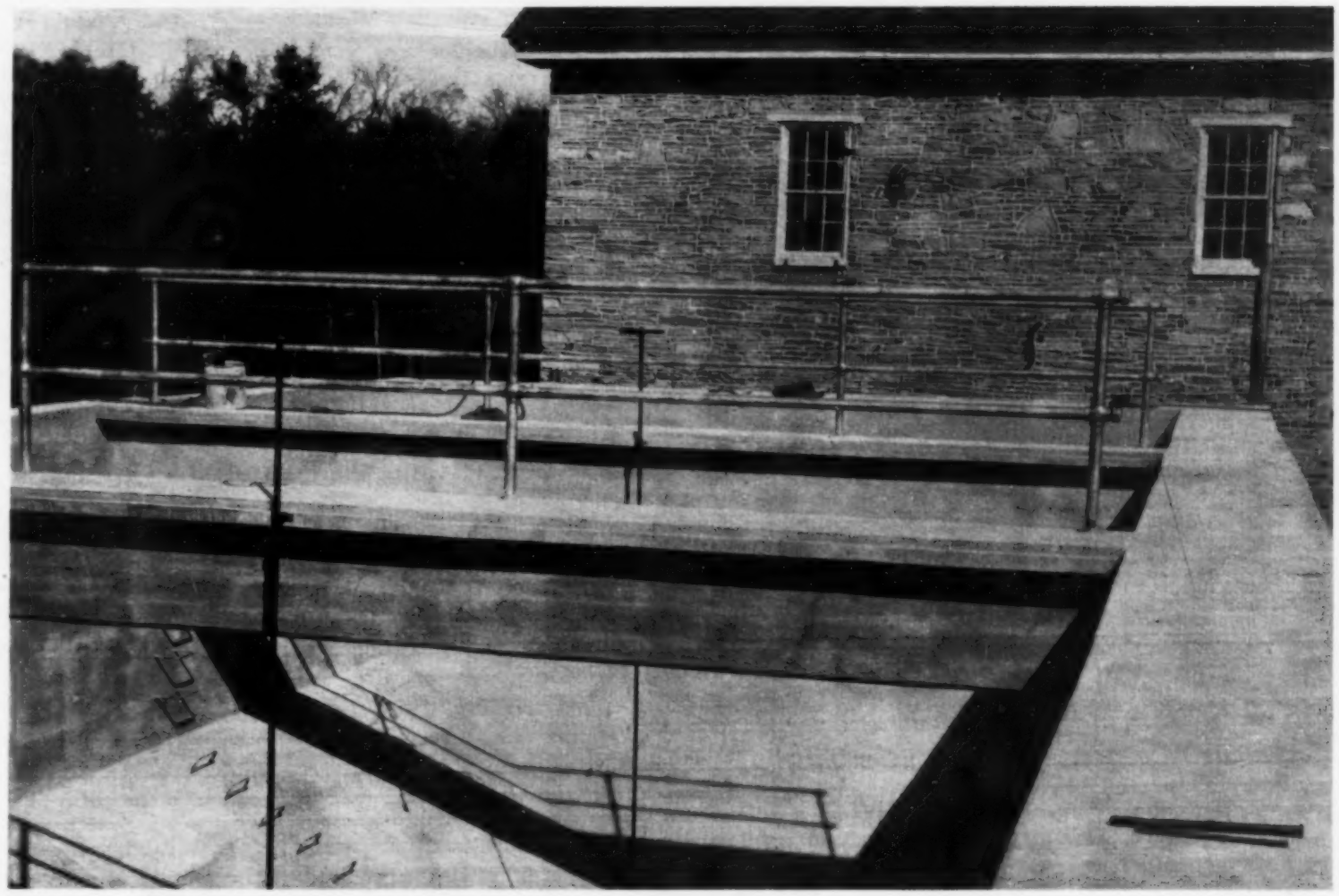
*One user of General Electric equipment on a shovel reported recently that he took the shovel out of service temporarily, a few weeks ago, not because he *had* to, but because he felt that after any equipment had been in use for five years without interruption it surely deserved a rest for inspection. Performance records like this speak for themselves.

GENERAL ELECTRIC equipment for modern electric shovels has been developed by 30 years of co-operation between leading shovel manufacturers and G-E engineers—co-operation that exactly fits the equipment, both electrically and mechanically, to your needs. The results—from the experience* of users: dependability, economy, freedom from expensive maintenance; in short, year-in and year-out satisfaction. General Electric, Schenectady, N. Y.

Years of active teamwork on the part of builders of construction equipment, construction men, and General Electric have resulted in matched equipment—the kind that keeps the toughest job running smoothly at top speed; the kind that completes the job *on time*. See General Electric for all types of electric equipment for construction machinery — motors, control, motor-generator sets, portable substations, wire and cable, insulators, transformers, cutouts, locomotives, battery-charging equipment, and floodlights.

GENERAL ELECTRIC

"WE WANTED TO BE SURE TO GET DENSE, UNIFORM CONCRETE"



"SO WE USED 'INCOR' CEMENT"

"WE wanted to be sure to get dense, uniform concrete, free from porous areas," says Robert Hall Craig, Consulting Engineer, who designed the sedimentation basin (shown above) for Mechanicsburg Gas & Water Co., at Yellow Breeches Creek, Cumberland Co., Pa. "Besides," continues Mr. Craig, "it was necessary to hasten removal of a difficult form design. So we used 'Incor' 24-Hour Cement."

Yes, rapid curing with 'Incor' means earlier form removal. And it also overcomes one of two big problems in obtaining watertight concrete. Too much mixing water is one—too little curing is the other. 'Incor' can't control the former, but it can and does help overcome the latter problem.

To be watertight, ordinary concrete has to cure 10 days—too long for most jobs. Because 'Incor' is a better Portland Cement, it cures thoroughly in one-fifth the usual time—making it that much easier to get well-cured, watertight concrete.

Write for copy of new illustrated book entitled "Watertight Concrete." Address 'Incor,' Room 2200, 342 Madison Ave., New York. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

*Reg. U. S. Pat. Off.

'INCOR' 24-Hour Cement

COMPLETE LINES OF TIRES FOR EVERY CONSTRUCTION SERVICE AT LOWEST PRICES—GIVING LONG MILEAGE AND GREATER ECONOMY

FIRESTONE pioneered the ship-by-truck movement in 1918, and ever since has consistently led in anticipating every requirement in the design and construction of truck and bus tires for every transportation condition. To accomplish this, Firestone has consistently followed the fundamental principle of its founder and active head, Harvey S. Firestone, "Always to find the way to build tires better than anyone else."

While there are many reasons why Firestone Tires are safer and more economical, there are two reasons that stand out above all others. One is Gum-Dipping; and the other is two extra layers of Gum-Dipped cords under the tread.

By Gum-Dipping, every strand in every cord is soaked in liquid rubber, preventing friction—adding extra strength and long mileage. By having two extra layers of Gum-Dipped cords placed between the tread and cord body, it is practical to use a tread with higher, more rugged shoulders and a deeper non-skid with flatter contour.

All this provides more rubber on the road, giving longer wear, greater traction and quicker stops. These two extra construction features are patented and used only in Firestone Tires. Take a forward step in maintaining schedules and reducing operating costs. Call on the Firestone Service Store or Firestone Service Dealer today.

Firestone
HIGH SPEED TYPE
Greatest tire ever built for all-round service.

Firestone
OLDFIELD TYPE
The tire that taught thrift to millions.

Firestone
SENTINEL TYPE
Volume production tire for light trucks.

Firestone
GROUND GRIP TYPE
Super traction tire for unimproved roads.

★★★★★ *Listen to the Voice of Firestone—featuring Richard Crooks, Gladys Swarthout, or Nelson Eddy—every Monday night over N. B. C.—WEAF Network . . . A Five Star Program*

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FIRESTONE TRUCK TYPE BATTERIES

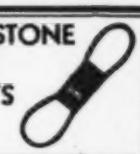
FIRESTONE HEAVY DUTY SPARK PLUGS

For quick starts and longer mileage.

FIRESTONE BRAKE BLOCKS and HEAVY DUTY LINING

For better braking control.

FIRESTONE FAN BELTS



FIRESTONE RADIATOR HOSE

Firestone

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LINK-BELT SHOVEL NEWS

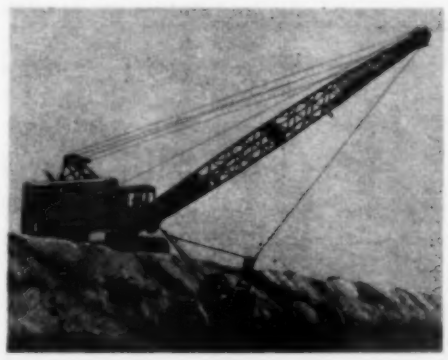
for Contractors, Road Builders and Engineers

25,000,000 Tons of Granite

That is the estimated quantity of granite rock still remaining in this 126-year-old quarry of the Port Deposit Quarries Co., Inc., Port Deposit, Md.

This Link-Belt K-30 crawler gas crane is rendering continuous, dependable service in handling all sizes of stone, from the "one and two-man size" which is shown being loaded into cars from a hand-filled tray, up to large blocks weighing as much as 17 tons.

Utah Lake Channel Project



Utah Construction Co. and Morrison-Knudsen Co., acting jointly, recently completed work on this emergency drought relief project. It involved the digging of a new and deeper outlet on Utah Lake near Salt Lake City, to permit the flow of water which had receded below the regular channel.

Four Link-Belt heavy-duty K-55 draglines rendered their usual, dependable, speedy service on this job.

In November, 1934, Utah Construction Co. purchased two more K-55 draglines making a total of seven Link-Belts purchased by that company since 1928.

At the Bonneville Dam

Columbia Construction Company's Link-Belt shovel loading ballast used for sinking cofferdam cribs, for the main spillway dam of Bonneville project in Oregon.

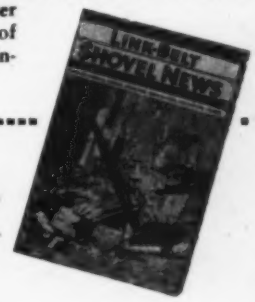
Several Link-Belts are used by Orino, Bell & Malcolm on their $847,247 contract covering the relocation of O. W. R. R. & N Co. railroad along the Oregon shore, as part of the Bonneville dam and navigation project—42 miles east of Portland. This re-location work necessitates driving a 550-ft. double-track tunnel; building two steel bridges on concrete piers, and one concrete arch bridge; 150,000 cu.yds. of solid rock excavation; 250,000 cu.yds. of common excavation; 10,250,000 sta.yds. of overhaul; and 300,000 cu.yds. producing and placing riprap.

Regarding Stability

This Link-Belt K-55 dragline owned by R. H. Risser, Hazleton, Pa., is shown stripping anthracite coal. It is equipped with a 2-yd. bucket and 85-ft. boom, and at times has stripped to a depth of over 60 ft.

Equipped with a 3-cu.yd. clamshell bucket, weighing 7,000 pounds empty, and approximately 11,000-pounds loaded, it is also used for loading coal from storage to cars. In this work it is operated at a radius far in excess of its rated lifting capacity, but in spite of this is working very satisfactorily.

Operating on a 70-ft. radius the machine loads a 99-cu.yd. car with 10% topping, in 22 minutes, requiring 38 passes of the bucket. Anthracite coal weighs approximately 55 pounds per cu.ft., so the average load is approximately 2 tons of coal, or an output of between 75 to 80 tons in 22 minutes. This is an average rate of better than 100 trips per hour. It is an example of the unusual stability and large capacity obtainable with Link-Belts.



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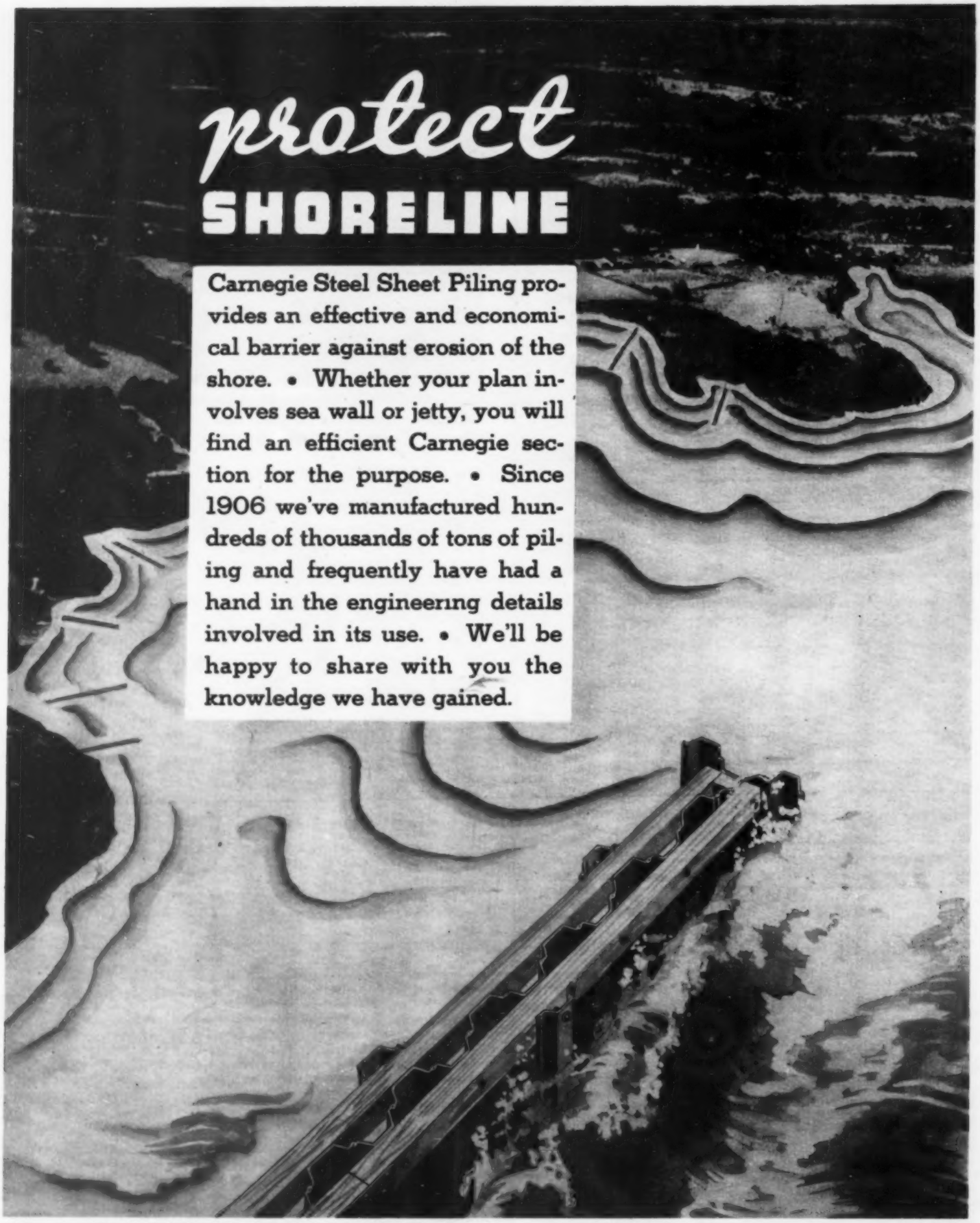
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Carnegie Steel Sheet Piling provides an effective and economical barrier against erosion of the shore. • Whether your plan involves sea wall or jetty, you will find an efficient Carnegie section for the purpose. • Since 1906 we've manufactured hundreds of thousands of tons of piling and frequently have had a hand in the engineering details involved in its use. • We'll be happy to share with you the knowledge we have gained.

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12 QUESTIONS to ask the BLACK TOP PAVER SALESMAN

QUESTIONS

1. Do you make all joints by cutter bar action?

On the Adnun, parallel joints are made by the overlapping action of the cutter bar which carries the material up to the abutting course and compresses it in place leaving a joint of the same level and texture as the rest of the course.

2. Does the pavement being laid depend on floating mechanisms or the solid accuracy of a correctly laid course?

The Adnun lays Black Top the way it should be laid—riding on the course itself. The newly laid road being perfectly smooth provides an unequalled gauge, a template that assures continued smoothness as the road is laid. There is no friction set up by runners, no dependence on floating mechanisms or springs to equalize the mistakes the paver is making.

3. Do you require a finished subgrade?

As the Adnun rides on its own accurately laid course it does not require a subgrade of as high a finish as that necessary for a machine riding on the subgrade.

4. Is your machine self correcting?

The Adnun, because of the ratio caused by the difference between the distance from rear rollers to the cutter bar and cutter bar to the front wheels, reduces the depth of the depressions with each course (ask for explanation of this feature)

5. Do you require forms?

The Adnun needs no forms or shoulder preparation.

6. Have you a two-speed cutter bar?

The Adnun provides a two-speed cutter bar that assures handling all types of mix with maximum efficiency.

7. Have you a fine adjustment?

The Adnun provides a fine adjustment that assures absolute accuracy.

8. Have you a quick lift?

With the Adnun quick lift the cutter bar is instantly retractable.

9. Have you a power cut off?

The Adnun power cut off assures instant control of the flow of material to the grade in a straight edge. This is invaluable on city work.

10. Is your spreader box clear of driving mechanism?

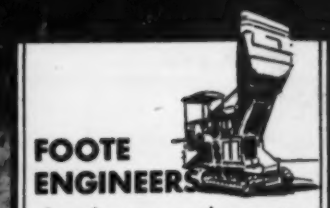
All driving mechanism for the raker bar is outside of the spreader box where it will not be affected by material or interfere with the dumping of the trucks.

11. Is your machine fully controlled from the operator's deck?

All controls on the Adnun are banked within easy reach of the operator.

12. How long have you had machines in service?

Adnuns have been in service for over 4 years in almost every State. When you buy an Adnun you buy a proved machine.



FOOTE ENGINEERS

have kept pace with concrete road problems. The MultiFoote Paver is absolutely up to the minute—the latest thing in concrete pavers. When you are in the market ask about its 10 points of superiority.

THE FOOTE COMPANY, INC.

World's largest exclusive builders of road pavers

NUNDA, N. Y., U. S. A.

ADNUN

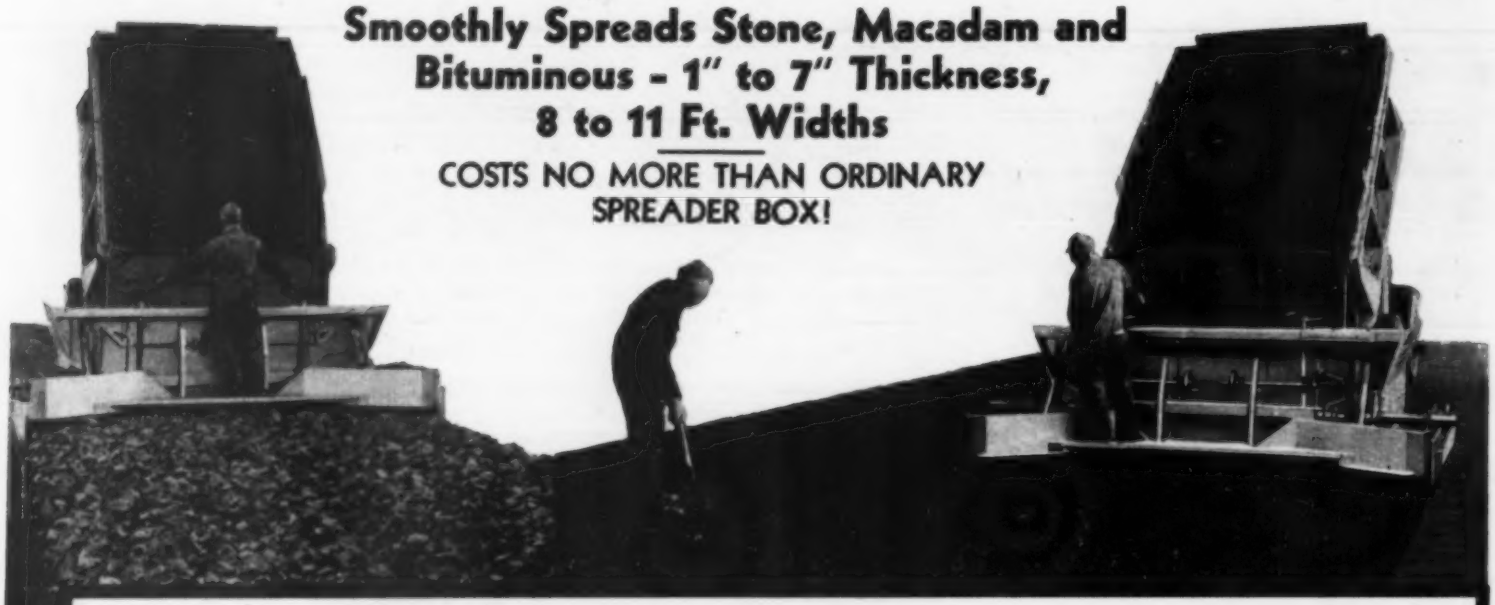
TRADE MARK REGISTERED

BLACK TOP PAVER

JAEGER *Adjustable* SPREADER

Smoothly Spreads Stone, Macadam and Bituminous - 1" to 7" Thickness, 8 to 11 Ft. Widths

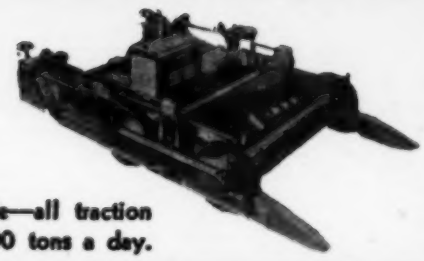
COSTS NO MORE THAN ORDINARY SPREADER BOX!



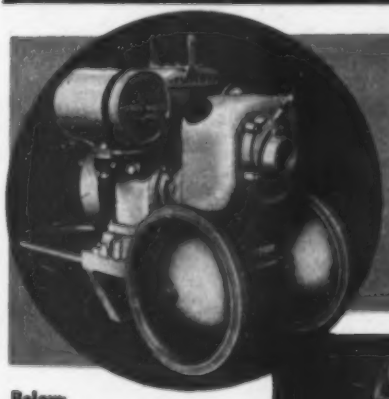
Jaeger Dust Blower

Clears 6-ft. paths, insures perfect bond for black top pavements.

Jaeger Bituminous Paver
Power Propelled, Width Adjustable 9 to 15 Ft.



For smooth, precision finished roads, without forms—full floating 18-ft. straight edge runners equalize subgrade—all traction on hard surface. Capacity 400 to 1000 tons a day.



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810 Extra for Rubber Tires
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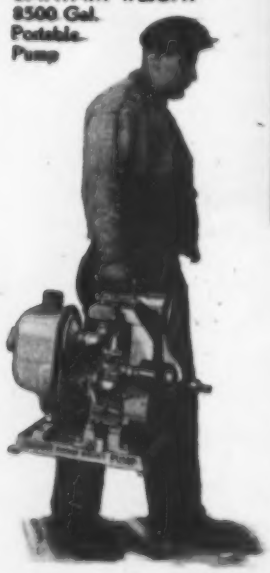
8500 Gal.
"Handy Model"

Below:
"BANTAM WEIGHT"
8500 Gal.
Portable
Pump



JAEGER "SURE PRIME" PUMPS

(10,000 TO 135,000 GALLONS)

Built in 2", 3", 4", 6" and 8" sizes, Jaeger Heavy Duty Self-Priming Centrifugals are world's largest selling pump of their type for construction jobs, industrial work, public utility and municipal maintenance, etc.

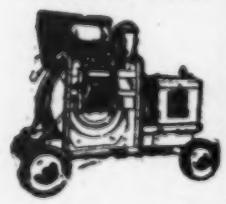
JAEGER WELL POINT SYSTEMS provide "dry job" conditions at lowest known cost. Used on small jobs and biggest. Send for new CATALOG P-35.

LOOK the 10S SPEED KING

Build Your Bridges with this

END DISCHARGE 2-BAGGER!

Also built with side discharge, 4 wheels.

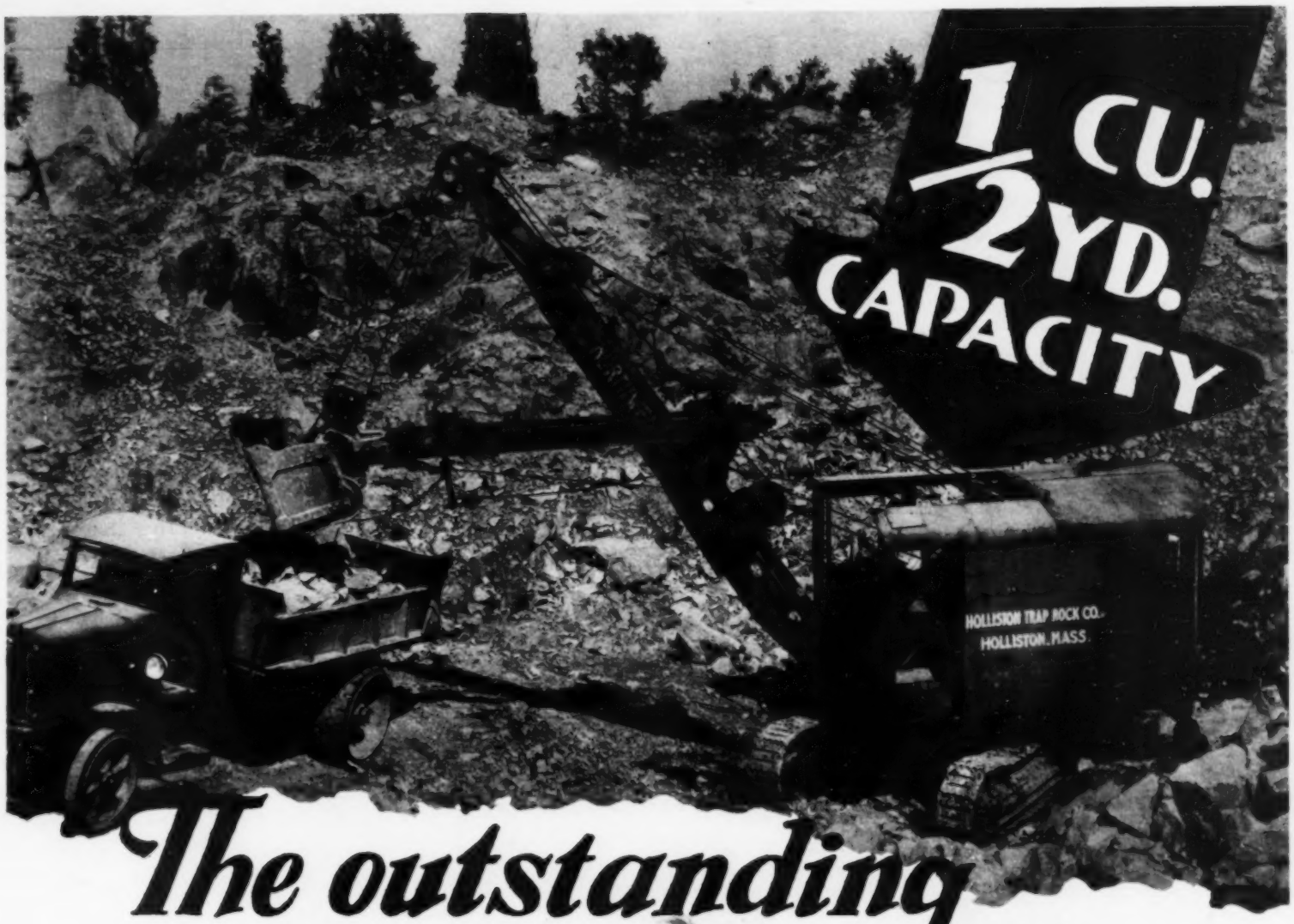


Full 2-bag capacity, plus END DISCHARGE, speeds up production and cuts your costs by discharging direct into bridge forms, pouring walks, floors, alleys with swinging spout, saving street space, saving wheelers.

Big brother to the famous Speed King 7S.

WRITE FOR CATALOG N-35 AND NEW LOW PRICES

THE JAEGER MACHINE COMPANY • 800 Dublin Ave., Columbus, Ohio



The outstanding ½ Cu. Yd. Shovel! . . . .

COMPARE IT POINT BY POINT

The Northwest Model 2, ½ yd. shovel is a big full sized, heavy duty ½ yd. machine not to be compared with the average ½ yd. shovel offered by other manufacturers.

Compare it point by point.

- **Both upper and lower machinery frames are heavy steel castings.**
- **It steers with full power on both crawler belts while turning, as well as when going straight ahead.**
- **All high speed shafts roll on ball or roller bearings.**
- **The power take-off is the equivalent of the finest speed reducer—helical cut gears running in oil.**
- **The "feather-touch" clutch control reduces operating fatigue, speeds up operation and increases output.**
- **Full convertibility gives you a machine that will meet every problem.**

SHOVELS, CRANES, DRAGLINES, PULLSHOVELS, SKIMMERS

Built in a range of **10 SIZES** *½ yd. capacity and larger*

GASOLINE, OIL, DIESEL OR ELECTRIC POWERED

NORTHWEST ENGINEERING CO.

The world's largest exclusive builders of gasoline, oil, diesel or electric powered shovels, cranes, draglines, pullshovels and skimmers

1728 Steger Building, 28 East Jackson Boulevard, Chicago, Illinois, U. S. A.

BREAK UP THE "MAT" FIRST
In Highway Fill Settlement Work

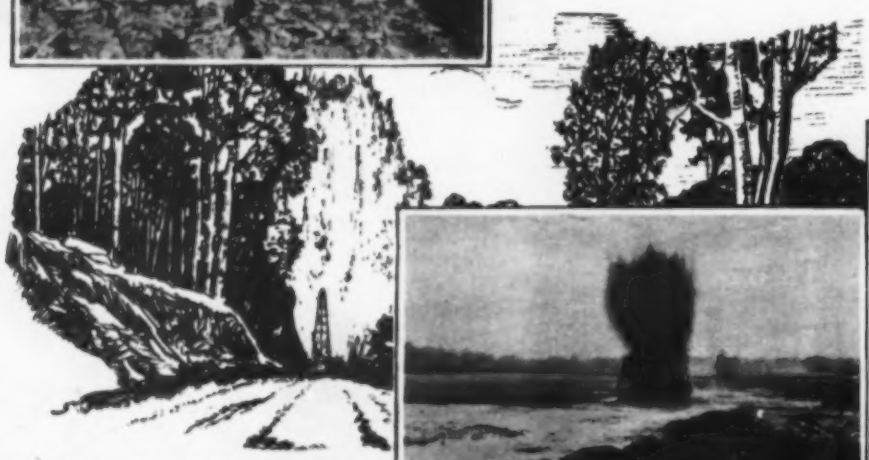
One-half "Mat" removed.
Loading other half

The so-called "mat," which covers the surface of most swamps, is a layer of sod, roots, brush, small trees and debris that is troublesome, tough, and tenacious. Fill placed upon it will tend to float or settle unevenly and once underneath the fill it prevents complete and rapid settlement and is difficult to remove.

Break up this "mat" by the use of explosives *before* the fill is started. Facilitate movement of new fill material and provide for complete and rapid settlement. Proper blasting not only breaks up or removes the "mat" itself but actually tends to direct the fill straight downward.

Pre-fill blasting is more spectacular than deep under-fill blasting but it is nevertheless essential. In some cases good preliminary surface blasting permits complete settlement of the fill.

Explosive service on a fill settlement job should come before a yard of fill is placed. See the Atlas representative. Atlas offers the right explosives for all fill settlement work.



The photographs on this page reproduce fill settlement work at Chicamuxen, Maryland, under the direction of E. L. Mustard. Photographs by L. W. Carr, Maryland State Highway Commission

After "Mat" Shot was made

The Blast—"Mat" Removal

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

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ATLAS
EXPLOSIVES

HARNISCHFEGER

Presents

The P&H BANTAM WEIGHT

(MODEL 100 - 3/8 - yd.)

A REAL CHAMPION FOR LOW COST DIRT MOVING

IT'S HUSKY AND FAST

As new as tomorrow's champion! A fast-moving, hard digging excavator that tips the scales at only 15,800 lbs.! It's a full-revolving 3/8-yd. machine that steps a year ahead in excavator design . . . does more for less money. . . . Liberally Powered by the smooth Ford V-8 motor, swift travel combines with easy steering, climbing and quick turning ability to give you tractor mobility. Swing speed is 5 RPM. Add to this the Live Boom Chain Crowd, and Split Second Clutches and you have the industry's fastest digging cycle.

Fully Convertible — The light boom makes practical converting on the job. Simplified design gives full convertibility at the industry's lowest cost.

Modern All-Welded Construction—reduces weight and increases strength. High grade alloy steels eliminate waste pounds. Machinery units placed behind the center of rotation cut down dead counterweight. Unit-built frame and side stands prevent weaving. Car-body is all-welded and cylindrical for greatest strength. First reduction gears operate in oil bath—helical gears are heat treated and double cut for long life and quiet operation. Anti-friction bearings are used at all vital points. The Bantam Weight can "take it" like a title holder.

HOW THE BANTAM WEIGHT MEASURES UP:

Capacity	3/8-yard
Engine	Ford V-8 (40 HP)
Weight	15,800 lbs.
Crowding Motion	P&H Rapid Reversing
Clutches	Split Second Control
Swing Clutches	Internal Expanding
Hoist Line Speed	162 F.P.M.
Dragline Speed	150 F.P.M.
Swing Speed	5 RPM
Travel Speed	1½ to 3 MPH
Tail Swing	7 Feet
Height to Top of Cab	10 Feet 4 inches

Bulletin No. 100 has complete specifications. Write for your copy.

HARNISCHFEGER CORPORATION

4494 W. NATIONAL AVE. *Established 1884* MILWAUKEE, WIS.

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What! Steel

Cheaper than Wood ?

You may be one of the many who think of timber as the cheapest material for building belt conveyor frames, and it was not so long ago that this was true. But now—it is hard to find a conveyor installation that would not be cheaper with the New Barber-Greene Standardized Conveyor Truss.

The B-G Truss is Pre-Engineered. You get the truss to support a given load for a given span or overhang.

It is shipped from stock—no costly delays.

It can be erected in a fraction of the time required for building a timber truss—and with less expensive labor.

Since much longer spans are possible, fewer bents are needed, not only saving the cost—but avoiding unnecessary ground obstructions.

The upkeep of a B-G Standardized Steel Truss Conveyor is much less than a wood frame. There is no sagging, rotting, or warping, and no fire hazard.

The belt life is greatly prolonged because the B-G steel frame is correctly aligned and retains this alignment.

All the idlers may be easily reached for lubrication and alignment. This is particularly important on the return belt idlers, which are very inaccessible in most timber frame construction.

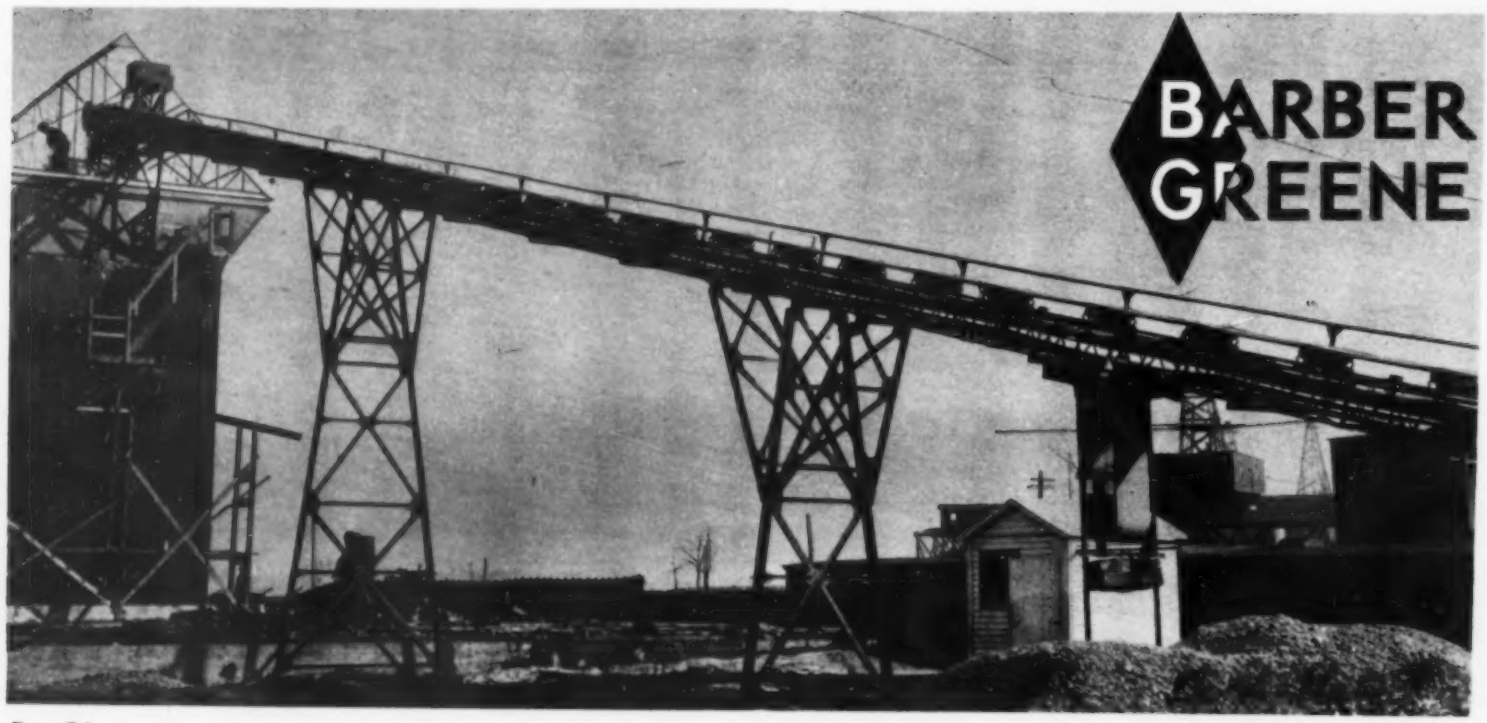
The decking in timber conveyors is usually flat, allowing the material to build up and stop the idlers. Curved (self-shedding) decking is furnished with the B-G Truss.

Then there is the tremendous advantage of flexibility that only Barber-Greene Standardized Conveyors can give. Your Barber-Greene can never be made obsolete by changes in your material handling system. It can be lengthened, shortened, or otherwise altered to meet changing conditions, or new set-ups. It is built to take all standard B-G Conveyor parts and accessories. For the same reason, there is always a high resale value on Barber-Greenes—much greater than the small salvage value of a timber frame conveyor.

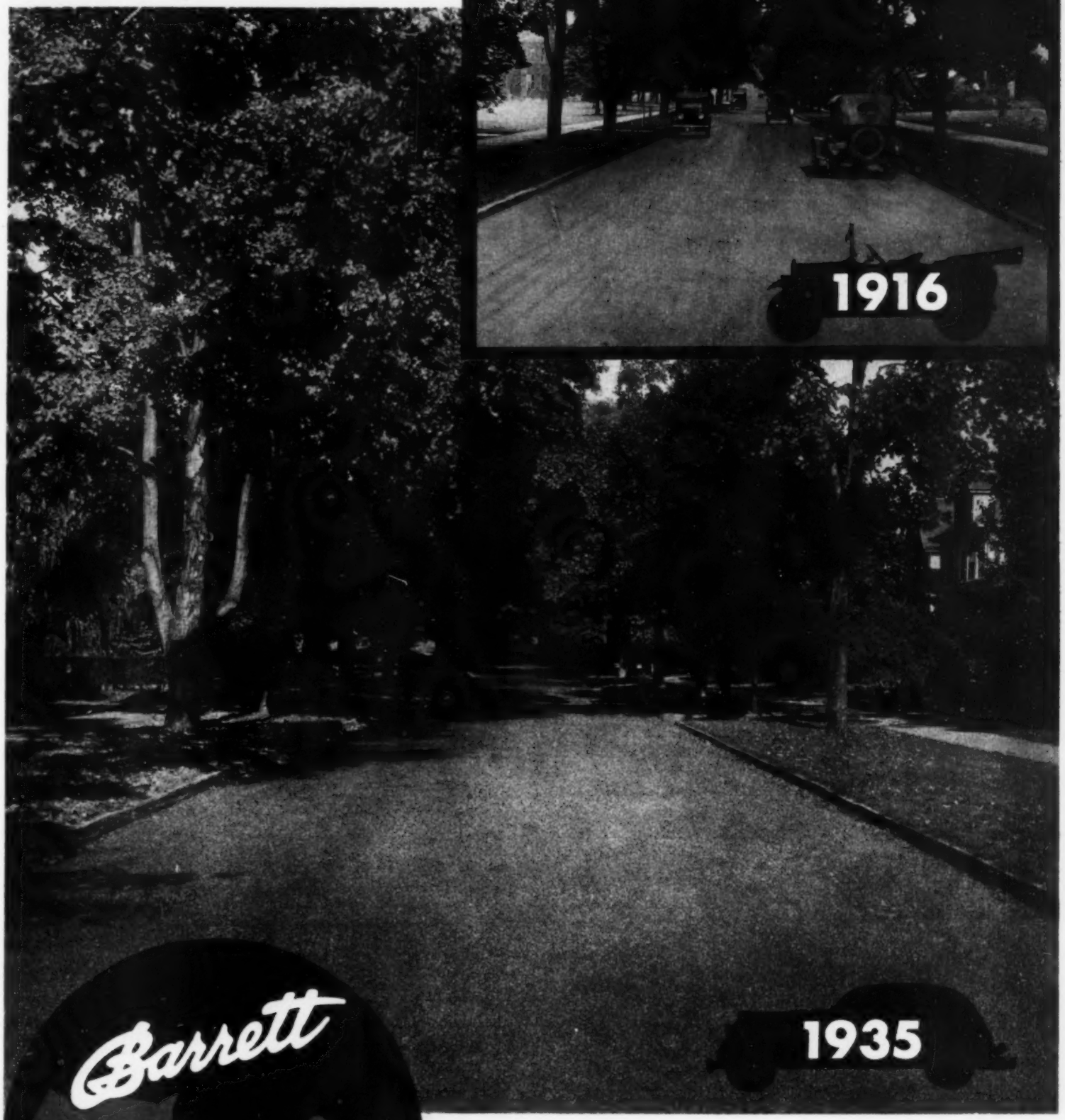
This is just a part of the story. A B-G representative will gladly call to discuss *your* material handling problems. There is no obligation.

BARBER-GREENE COMPANY
530 West Park Ave., Aurora, Ill.

35-10



Grove Street, Sewickley, Pennsylvania. Tarvia-built in 1916, the year which marked the beginning of Federal Aid road building. Lower photo shows condition of road today.



Barrett

Tarvia

GOOD ROADS AT LOW COST

Tarvia is made by America's oldest and most experienced manufacturer of coal-tar road-building materials. It is refined to rigid specifications which meet every road-building or road-maintaining need and fit every traffic requirement. Grove Street's nineteen years of flawless service—and this is not an exceptional Tarvia performance record—tells you how durable Tarvia roads are, and why Tarvia belongs in your road program. Phone, wire or write for details.

THE BARRETT COMPANY New York Chicago Birmingham Philadelphia St. Louis Minneapolis Hartford Detroit Cleveland Boston Buffalo Columbus Milwaukee Providence Syracuse Lebanon Toledo Cincinnati Baltimore Youngstown Bethlehem Rochester Portland, Me. *In Canada:* THE BARRETT COMPANY, LTD., Montreal, Toronto, Winnipeg, Vancouver

The *new* Koehring Wheel Dumptor 70-5

for hauling • dumping • spreading • • • •

20 miles per hour

The new 5 yard KOEHRING WHEEL DUMPTOR is the modern *high-speed* self-contained load carrying tractor. *Twenty miles* per hour, either forward or reverse. This high travel *speed,* with *speed* at the loading point and *speed* at the dump, establishes the 70-5 Dumptor as the outstanding *high speed,* economical tractor-type dirt moving unit.

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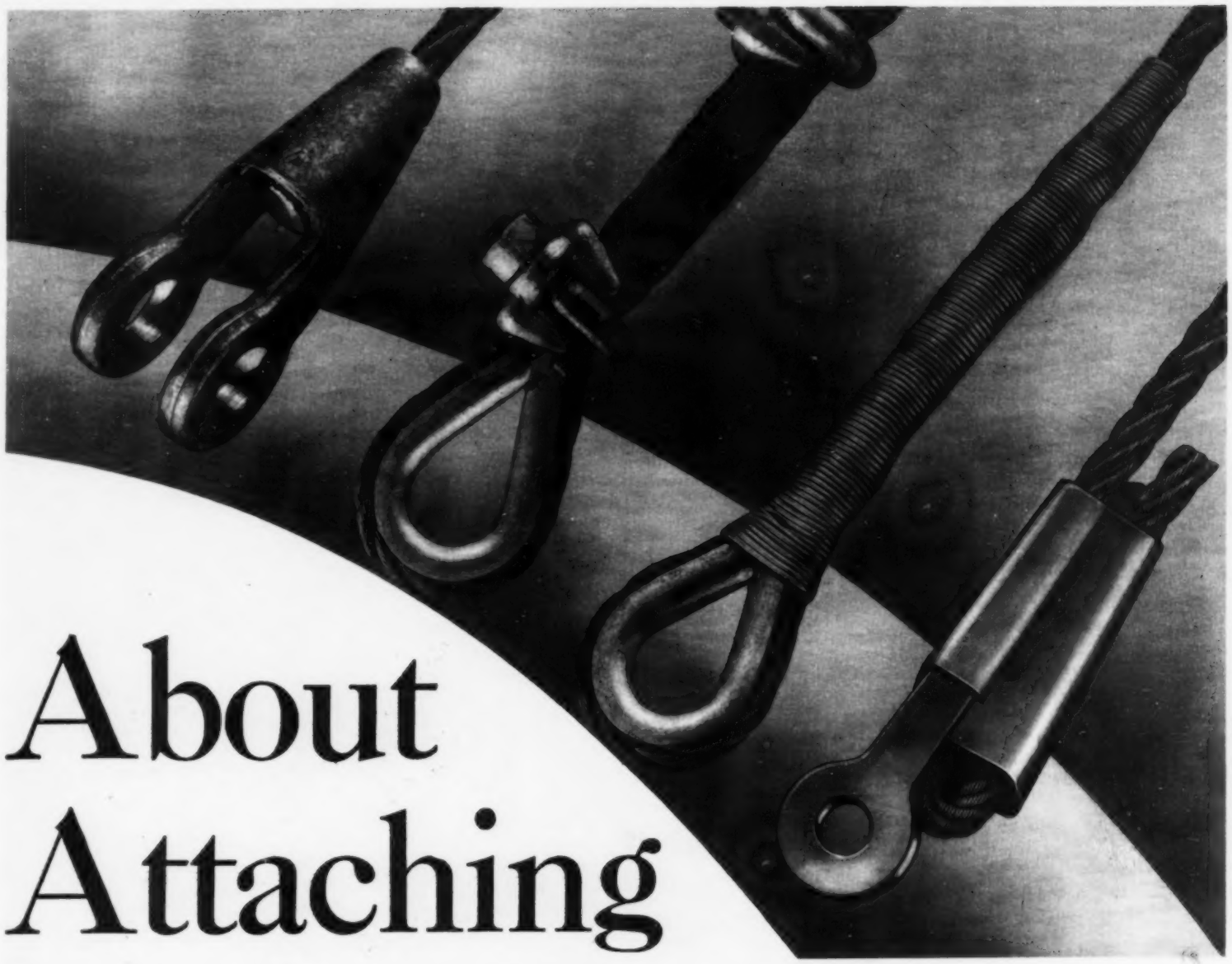


About Attaching

Know your Ropes ...This is a helpful hint, how to make wire rope last longer. Subsequent Wickwire Spencer advertisements in this publication will give other dollar saving information. Tell us about your rope problem and we will give you the answer.

Even though these attachments vary in strength from 80% to 100% of the full strength of the rope, there is a definite time and place when each may best be used irrespective of its decree of efficiency. Margin of safety, need for speed in making attachment, skill of men and facilities available are all factors. We would be glad to tell you the strength rating of each attachment, describe its advantages and limitations and tell you *where, when,* and *how* to use or not to use each. Write your request for this information.

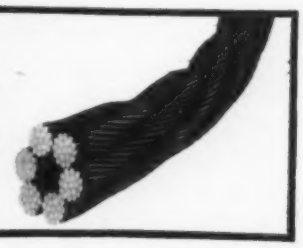
•

WICKWIRE SPENCER STEEL CO., New York City; Buffalo, Chicago, Worcester; *Pacific Coast Headquarters:* San Francisco; *Warehouses:* Portland, Los Angeles, Seattle. *Export Sales Dept.,* New York City.

WIRE ROPE
by Wickwire Spencer

BOTH...STANDARD LAY AND WISSCOLAY PREFORMED.

Wickwire Spencer manufactures all sizes and types of Wire Rope in standard lays and preformed. Wisscolay preformed wire rope will often solve a wire rope application difficulty. Ask our engineers where and when it should be used. Send for a free WIRE ROPE BOOK. It will prove of great value.



WHETHER weather or no, Bucyrus-Monighan walking draglines keep right on delivering big output at low cost. They don't mire down because, when digging, their ground-bearing pressure is distributed over the whole area of the base. The walking shoes are raised high off the ground, come down on fresh, unchurned sections when it's time to "walk" again. If a deep hole is encountered, the shoes can be raised and turned to a new location, or supporting material placed under them. If you "weatherproof" your jobs with Bucyrus-Monighans, you will be "Singing in the Rain" with profitable, all-weather output. Manufactured by Bucyrus-Monighan Company, Chicago, Illinois.

Weather

BUCYRUS MONIGHAN

Sold by

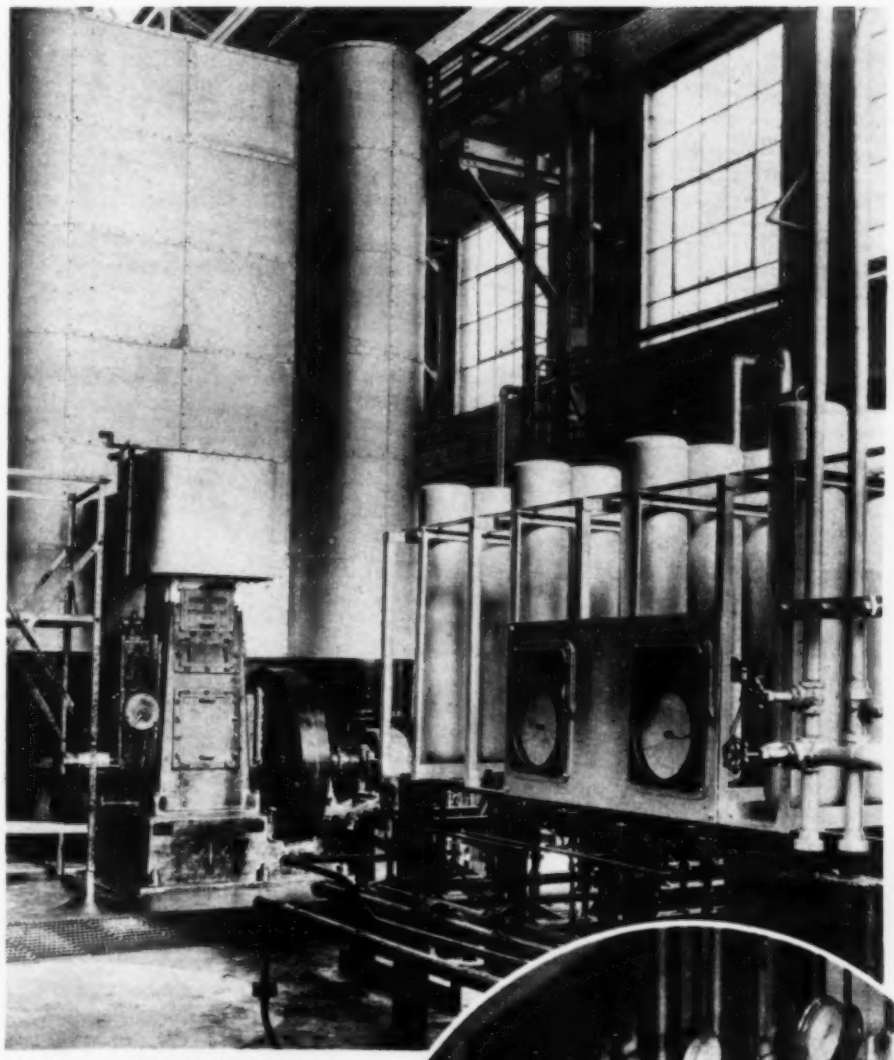
BUCYRUS-ERIE

EXCAVATING, DRILLING, AND MATERIAL-HANDLING EQUIPMENT...SOUTH MILWAUKEE, WISCONSIN

THE *NEW* 100% PENNSYLVANIA

Gulfpride Oil

IS *ALCHLOR* PROCESSED!



Liquid air is distilled in the tall insulated fractionating tower for separation into oxygen and nitrogen. The engine in front of the tower assists in the liquefaction of air prior to its fractionation for the ALCHLOR process

This unparalleled motor oil will give you DEFINITE Operating Savings

IN ADDITION to being a 100% Pure Pennsylvania Oil, GULFPRIDE—the world's finest lubricating oil—is super-refined by Gulf's exclusive and patented ALCHLOR process. This remarkable refining process removes 20 per cent more impurities—such as asphaltenes, petroleum resins, naphthenic acids, etc. Finely dewaxed, highly filtered and ALCHLOR processed—GULFPRIDE is an unparalleled motor oil!

GULFPRIDE'S high mileage performance offers truck and commercial car operators astounding savings on a cost-per-mile basis. It smashes all former ideas of low consumption—saves carbon removal expense, gives longest life, and lowers maintenance costs. GULFPRIDE gives the ultimate motor oil economy.

Gulf trained engineers will gladly survey your equipment and submit specific recommendations for economical lubrication.

During every stage of refining GULFPRIDE Motor Oils test samples are withdrawn to be carefully checked in the laboratory by trained Gulf chemists. GULFPRIDE quality is under constant supervision.

Features of the
NEW GULFPRIDE OIL

1. Double tough lubricating film.
2. High resistance to heat.
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7. Lowest cost per mile.

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GULF REFINING COMPANY, C.M.4
3800 Gulf Building, Pittsburgh, Pa.

I would like to have complete information and price quotations on the new Gulfpride Oil.

Name.....
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"VENTUBE"
MARCHES AHEAD!

After several years of experimenting with various types of couplings, the du Pont Company announces the "VENTUBE" Detachable Coupling. Tunnel engineers now have a strong, rugged coupling that will stand up against all conditions encountered while in service. The results of practical service tests involving various types of installations and conditions showed the following:

1. Positively eliminates loss of air at points where coupling is attached to tubing.
2. By keeping the inside of the coupling smooth and clear after it has been attached, it prohibits all loss of air due to friction caused by any obstruction in direct flow of air.
3. When properly attached, it cannot be pulled or jerked apart by concussion or pressure.
4. Comes equipped with specially constructed suspension hook that prevents sagging of the line at the coupling.
5. Heavy gauge copper plated, cold rolled steel was used to give this coupling the necessary rugged strength and to prevent rusting and corrosion.

DU PONT SUSPENSION HOOK

In the photograph below you will note that "VENTUBE" is suspended with a new type hook that comes attached to the suspension beam. This hook has been used with unusual success on tubing for mining and tunnel construction throughout the United States and abroad.

Tubing can be efficiently suspended and taken down with practically no loss of time.

Section nearest face can be telescoped back before firing and pulled back into place without disconnecting it from the regular suspension wire.

Due to its rugged construction and the method used in attaching the hook to the suspension seam, it is impossible to detach due to concussion or heavy pressure against tubing.

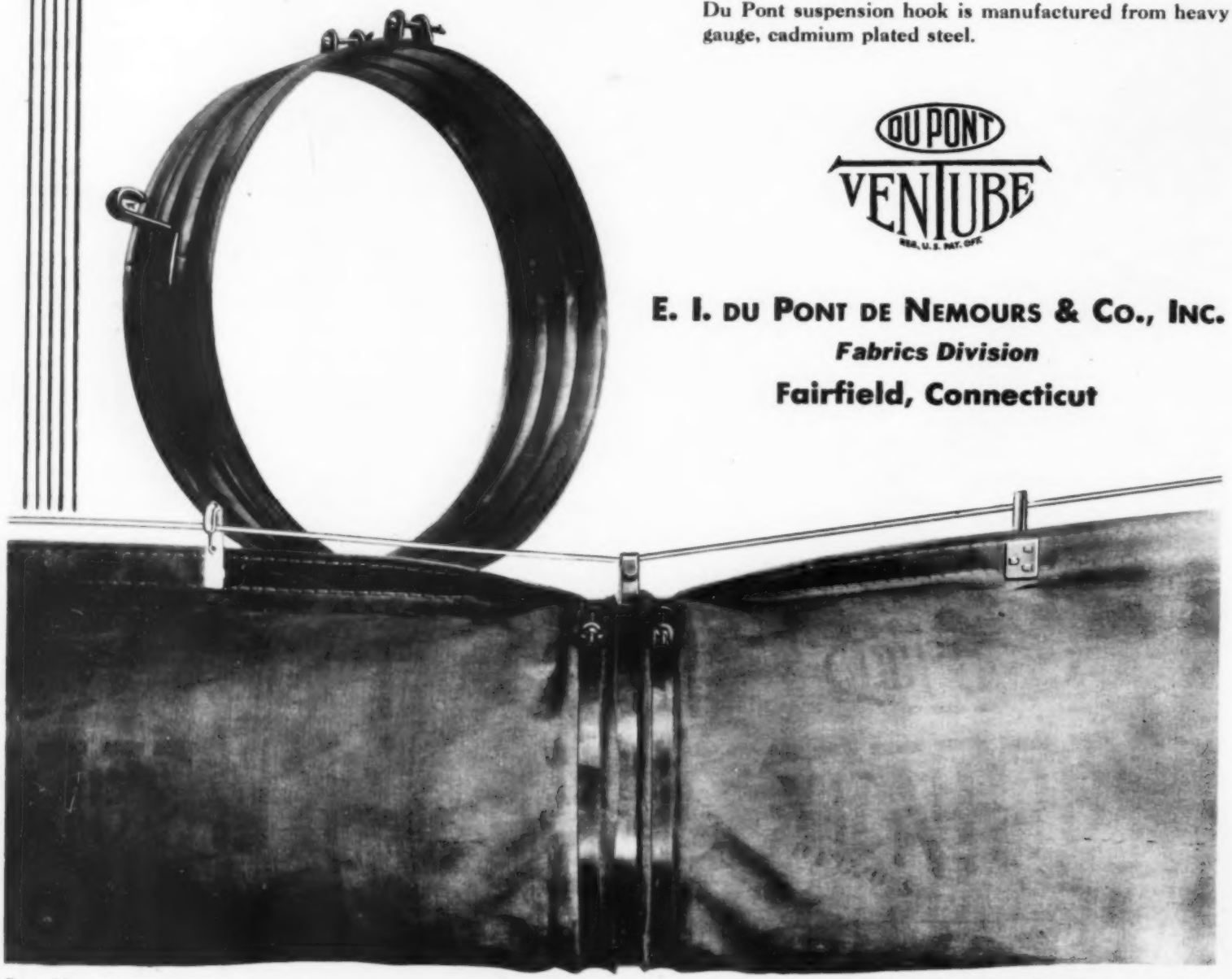
Du Pont suspension hook is manufactured from heavy gauge, cadmium plated steel.

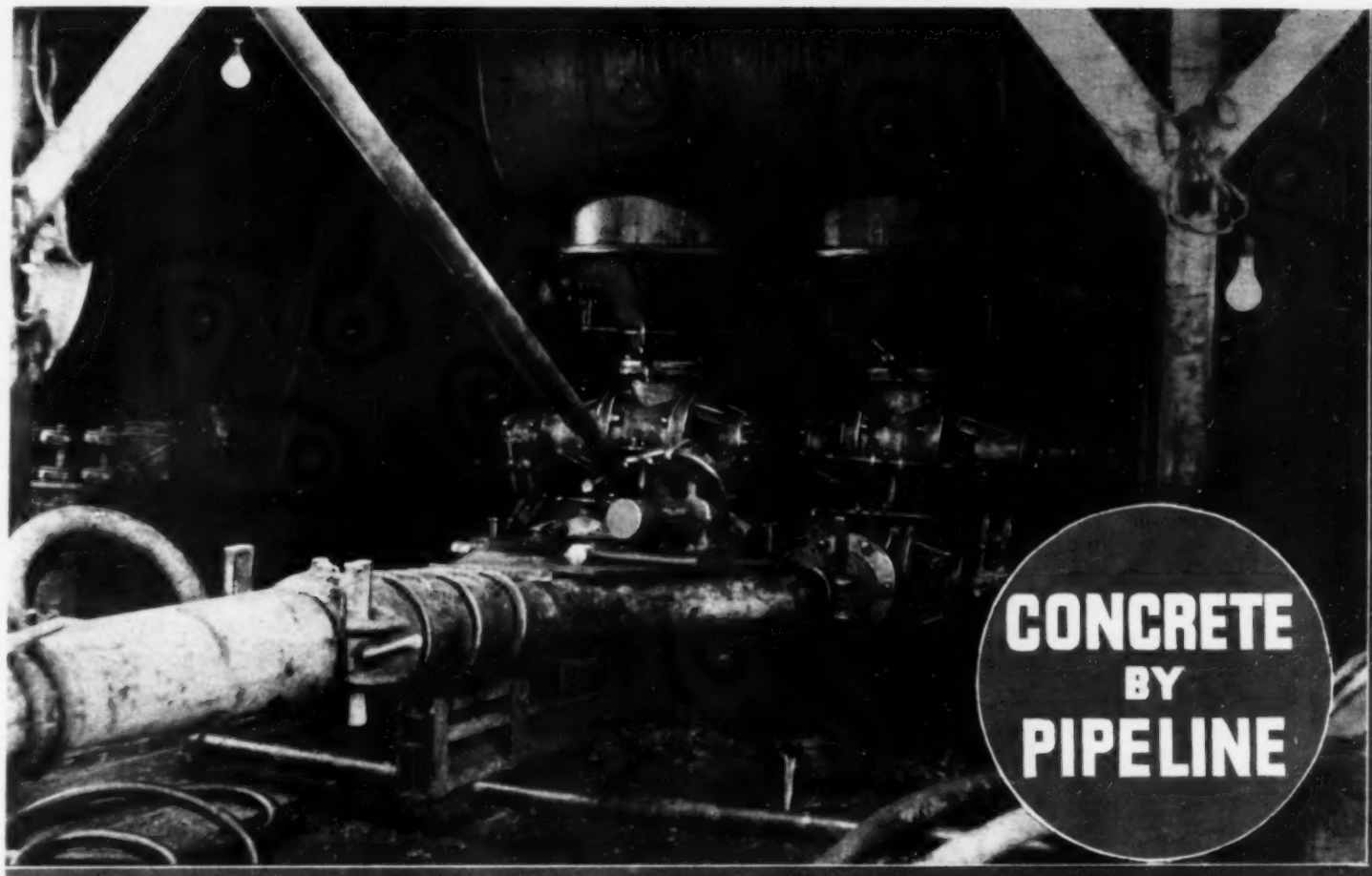
DU PONT VENTUBE REG. U.S. PAT. OFF.

E. I. DU PONT DE NEMOURS & CO., INC.

Fabrics Division

Fairfield, Connecticut





THE REX PUMPCRETE *means something* TO EVERY CONTRACTOR IN AMERICA

The Rex Pumperete is the greatest advance in placing concrete since man first built with cement.

Concrete by Pipe Line has a national background—on Boulder Dam—on Bonneville Dam—on the Mississippi River Development—on the Metropolitan Water District of Southern California—on San Francisco-Oakland Bay Bridge—on tunnels, sewage plants, post offices, hospitals, docks—and on every one of those jobs the Rex Pumperete was used by men who had never heard of it three years ago.

It's Coming—IT'S HERE

The facts are known—costs are known—conditions of operation are known—pipe line practice—every angle of operation, aggregates, water ratios—have been thoroughly tested and checked. When the Chain Belt Company says the Pumperete is O. K. for your job, you know that the Pumperete is O. K.—that it will place concrete in your forms at lower cost than any other way.

Before you bid any job, know what the Pumperete will do on it—if it's a Pumperete job, you'll be a whole sight better off bidding with the Pumperete than against it.

Don't go into this season without knowing about the Rex Pumperete—don't listen to grapevines—get the facts on the Rex Pumperete—the biggest thing in construction in many years. Send for the book, "Concrete by Pipe Line" now.

REX
PUMPCRETE

CHAIN BELT COMPANY

Home Office—Central and Northwest Divisions:
1664 West Bruce St., Milwaukee, Wis.

Eastern Division: 529 Chrysler Building, New York • Southern Division: 3704 Lexington Avenue, Dallas, Texas • West Coast Division: 909 Harrison St., San Francisco, Calif.

The Lowest Cost Way of Placing Concrete

It's here

THE NEW HUG

Interested in dump truck operating costs that are really *'way down?* Then meet the *new* Hug Definite Purpose Dump Truck.

Like the well-known Hug Roadbuilder, this new truck is designed and built exclusively for one specific purpose — dump truck work, the toughest there is. It performs every bit as economically per ton mile or on a yardage basis as the widely advertised light-weight makes that are merely *adapted* to this work. Yet it hauls bigger loads and hauls them faster. And — *get this* — it stays on the job till it's done! You have far less servicing and no costly lay-ups to eat profits. Also — *and this is important* — the Hug Definite Purpose Dump Truck is ready to go again *next* season — *and the next* — even longer. Not just a single season.

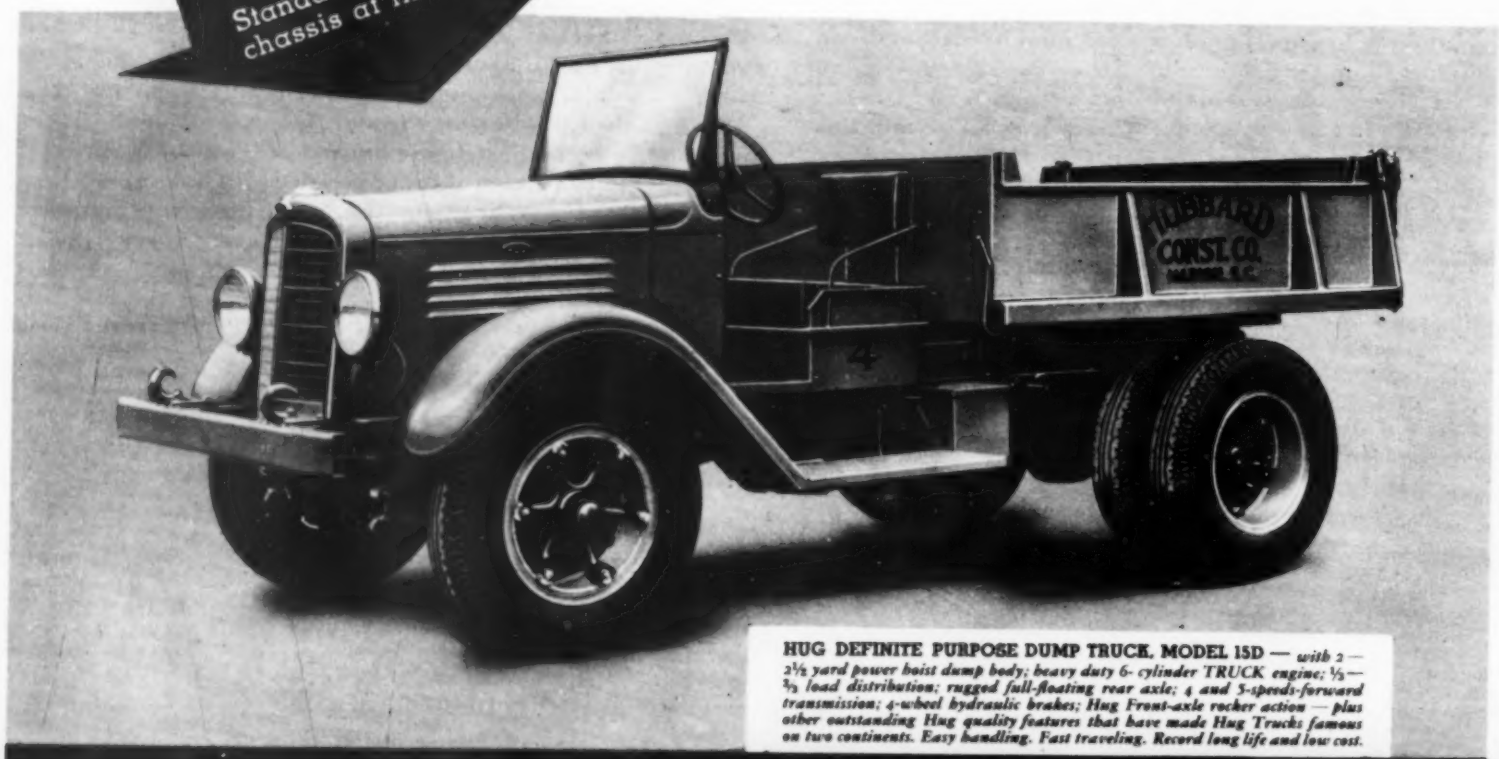
1¾-TON DEFINITE PURPOSE DUMP TRUCK with the famous Hug front-axle rocker action

You know the exceptional records that have made the mighty Hug Roadbuilder famous for years. This new Hug Definite Purpose Dump Truck is made of the same stuff — including the famous Hug front-axle rocker action that keeps the truck on an even keel, and eliminates twisting and bending of frame even in roughest going. Makes riding and driving easier, too.

Have your nearest Hug dealer demonstrate exactly what this truck will do right on your job, under every condition. You'll not be obligated. Call him today. Or write direct for complete information.

THE HUG COMPANY
510 CYPRESS STREET • HIGHLAND, ILL.

Price $1025
Standard Dump Truck chassis at the factory



HUG DEFINITE PURPOSE DUMP TRUCK, MODEL 15D — *with 2 — 2½ yard power hoist dump body; heavy duty 6- cylinder TRUCK engine; ½ — ⅔ load distribution; rugged full-floating rear axle; 4 and 5-speeds-forward transmission; 4-wheel hydraulic brakes; Hug Front-axle rocker action — plus other outstanding Hug quality features that have made Hug Trucks famous on two continents. Easy handling. Fast traveling. Record long life and low cost.*

"BUILT TO MEET A CONDITION"

I TRULY *Insensitive*

Only detonation can set it off—that's what we mean when we say Cordeau-Bickford is an *insensitive detonating* fuse. Neither friction, fire nor any ordinary shocks will explode it. As a consequence, it can be safely stored and handled.

That's why Cordeau is so safe to use—and one of the reasons why it will save you money. Both loading and hook-up are done with an insensitive detonating agent.

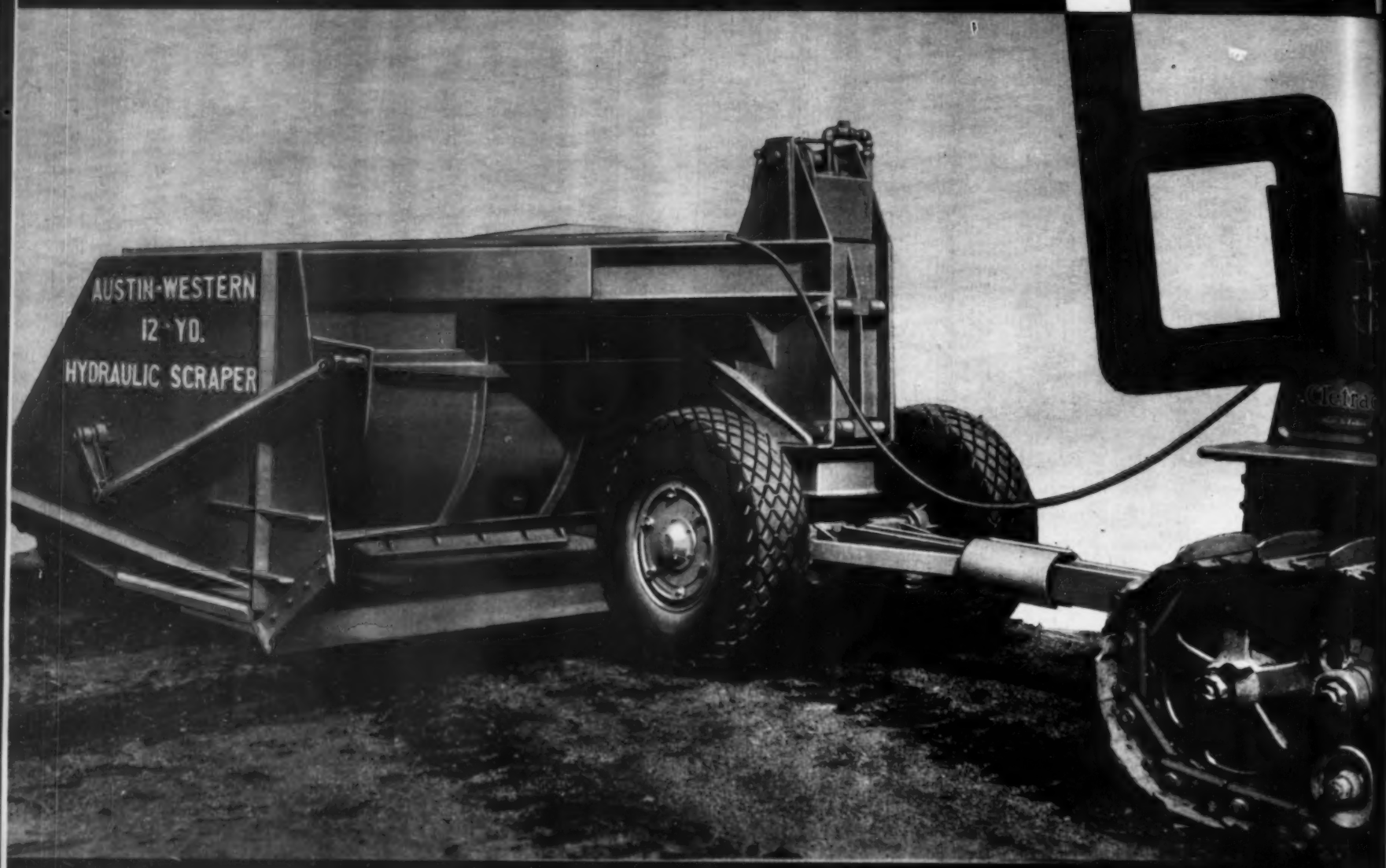
But the reduction of hazard is not the only way in which Cordeau-Bickford will save you money! There are four others. Ask us for them and then give Cordeau a "try." The Ensign-Bickford Company, Simsbury, Conn.
Estab. 1836

CORDEAU
DETONATING FUSE
BICKFORD

THE ENSIGN-BICKFORD COMPANY

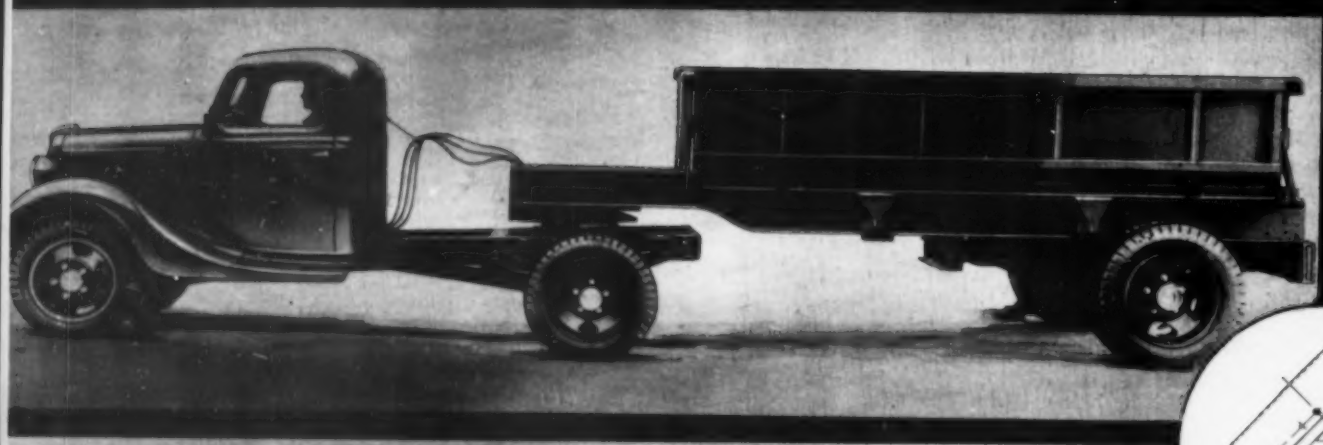
AUSTIN-WESTERN

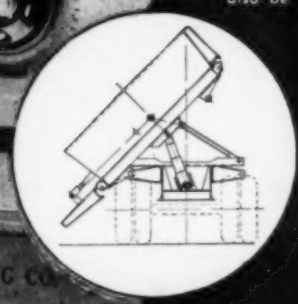
Announces



Carry-All Scraper

Entirely self-contained scraper, hydraulically operated and with its own motor, which raises or empties load. Does not dump, but forces load out. Completely open top—can also be loaded with elevating grader or shovel. Other features—operates with only 3 hydraulic cylinders, no cables, Timken bearings in wheels, no bell cranks.





Section through center showing dumping mechanism.

Trail-Cars of 6- to 30-Yard Capacity

All steel, most advanced pneumatic tire construction with no excess weight. Cab controlled. Two types: Side delivery 6 to 12 yard capacity; unlimited door clearance to handle anything that can be loaded. Hydraulic control.

Hopper type with bottom dump 6 to 30 yards (depending on weight of material handled). Air or manually operated. Clam shell doors have 18 inch clearance when material spreading is desired.

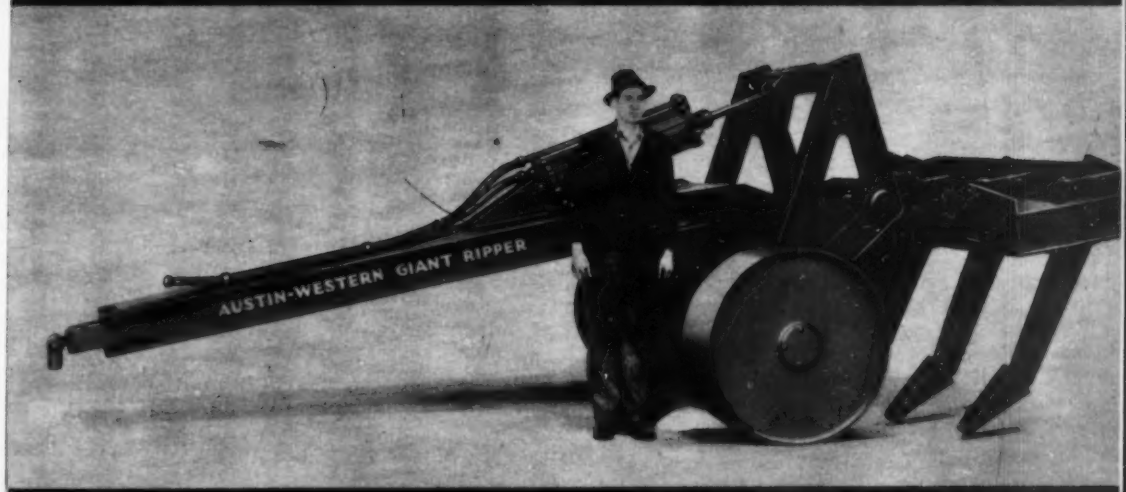
Units of this type move more than twice the load of a body mounted on a truck chassis.

NEW MACHINES

Hydraulically Controlled Elevating Grader. New 3 wheel design has manten steel trough type 48-inch carrier of huge capacity and hydraulically controlled furrow wheel which permits varying the width of the cut as conditions require. Double-acting hydraulic cylinder provides "stiff leg" operation of plow or "floating" operation, as desired.

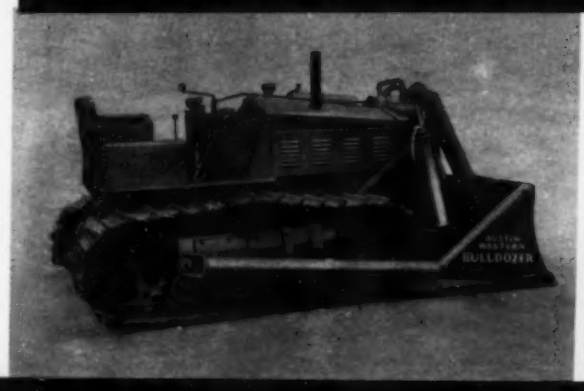
Ripper. Unbreakable. Cuts two feet deep. Strongest one-piece frame. Teeth hydraulically raised, or forced into ground. Teeth, capped with manganese castings, easily changed.

● Anticipating heavier demands on earth moving machinery in 1935 Austin-Western engineers first went into the field to determine the specific requirements—then designed and built equipment to meet them. Six new machines, announced herewith, offer every advantage based on modern earth moving methods. Each machine is very definitely superior to comparable equipment in the field. Send the coupon for bulletins.



Trailbuilder—
(Below). Less overhanging weight at front of tractor saves wear on tractor rollers and places center of gravity farther back. Adjustable push beams directly in line of draft. Lifting cylinders at front operate directly against load, raising less weight than on other machines. Positive hydraulic control of entire blade upward and downward, or of either end of the blade independently of the other.

Bulldozer—
(Below). Similar to the Trailbuilder, but without adjustable push beams and separate controls for the two ends of the blades. Same advantages of light weight, minimum wear, weight distribution, direct draft and positive hydraulic action of blade.



ROAD GRADERS · MOTOR GRADERS · ELEVATING GRADERS · DRAGS

ROAD ROLLERS

Austin-Western

DUMP WAGONS

BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS
SCARIFIERS · BULLDOZERS · TRAILERS · SCRAPERS · PLOWS

DUMP CARS

CRUSHING AND WASHING PLANTS · SWEEPERS AND SPRINKLERS · SHOVELS · CRANES · ETC · SNOW PLOWS

The Austin-Western Road Machinery Co.
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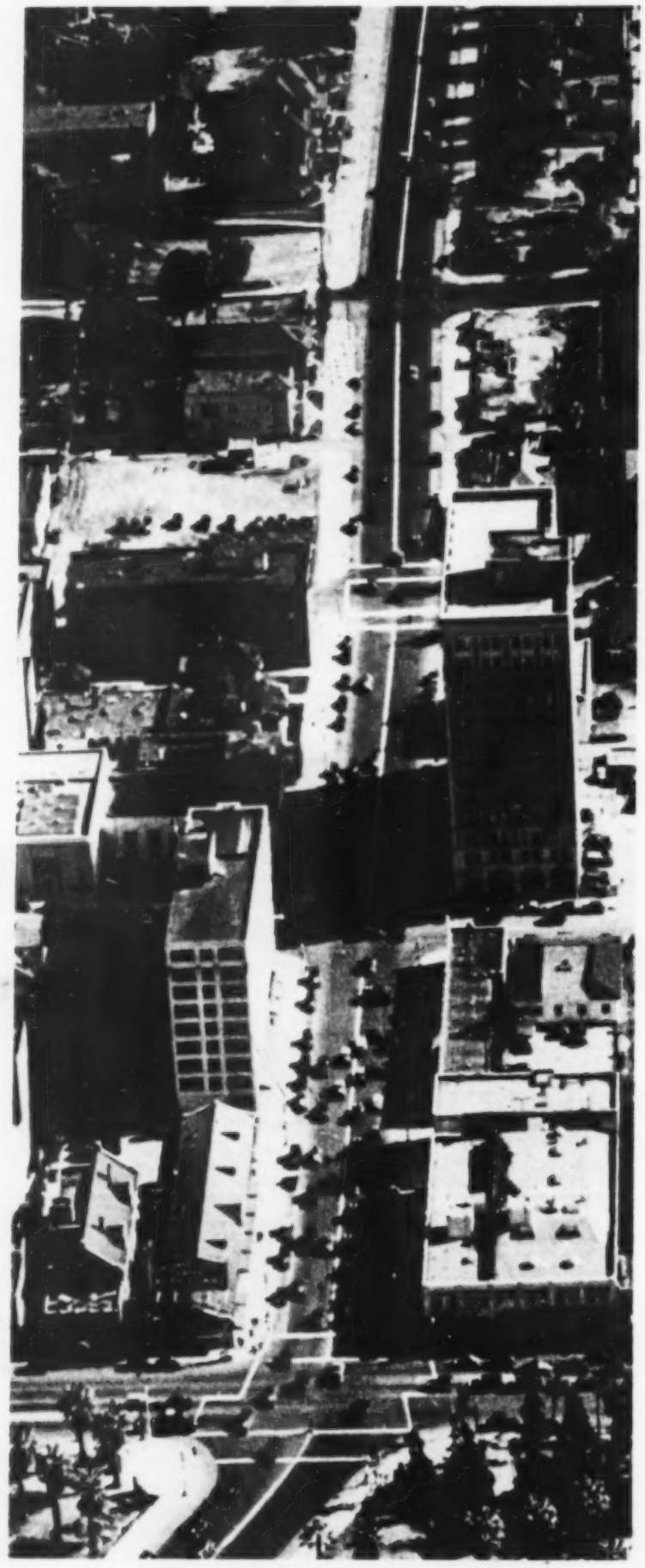
Units of this type move more than twice the load of a body mounted on a truck chassis.

VISIBLE—FROM ANY ANGLE!



Atlas White Traffic Markers show up, clear and distinct, even from 1500 feet altitude.

YOU'RE in a plane, 1500 feet up, as you look down on Wilshire Boulevard, Los Angeles, in the view at the left. See how sharp and well-defined and *white* those concrete traffic markers are! You can't miss seeing them. And the drivers of those cars down there see them lots more clearly.

Those markers, when this picture was taken (and you see it just as the camera caught it), were just a little more than six months old. Six months of traffic hasn't dimmed them or dirtied them. Six months of weathering hasn't faded them. And six years from now these white concrete markers will be guiding traffic just as efficiently —because they are *built* white and they *stay* white.

Atlas White traffic markers are built *into* the pavement. They are made of solid white concrete. They have a dense, solid, hard, white surface. Once installed, they never wear away, they never fade out, they never need replacement. They last as long as the pavement lasts. Their first cost is the last cost. They are *indelibly* white.

Write for complete information on these effective, economical, white concrete traffic markers to

UNIVERSAL ATLAS CEMENT CO.
208 South LaSalle Street, Chicago
(*United States Steel Corporation Subsidiary*)

The Atlas White Traffic Markers that are so clearly visible in the view at the left were installed on Wilshire Boulevard, Los Angeles, by the Griffith Co. of Los Angeles, under the supervision of the City Engineer.

185

ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement—Plain or Waterproofed

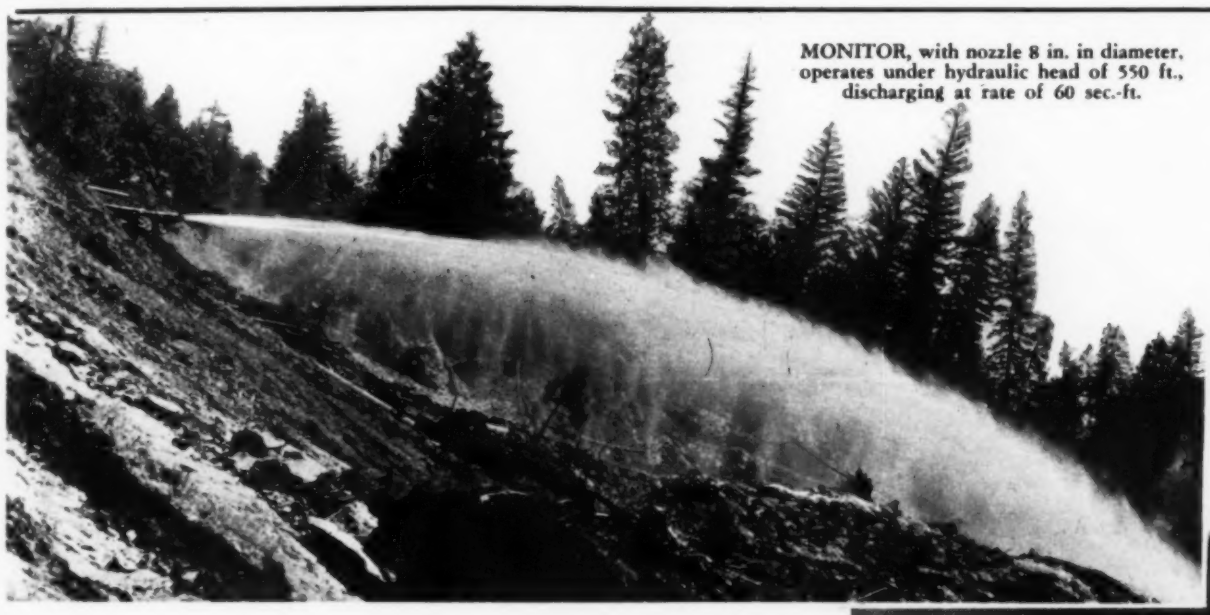
Construction Methods

NRA CODE

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc.

Volume 17—Number 4—New York, April, 1935



MONITOR, with nozzle 8 in. in diameter, operates under hydraulic head of 550 ft., discharging at rate of 60 sec.-ft.

HYDRAULIC GIANTS *Make Highway Cut*

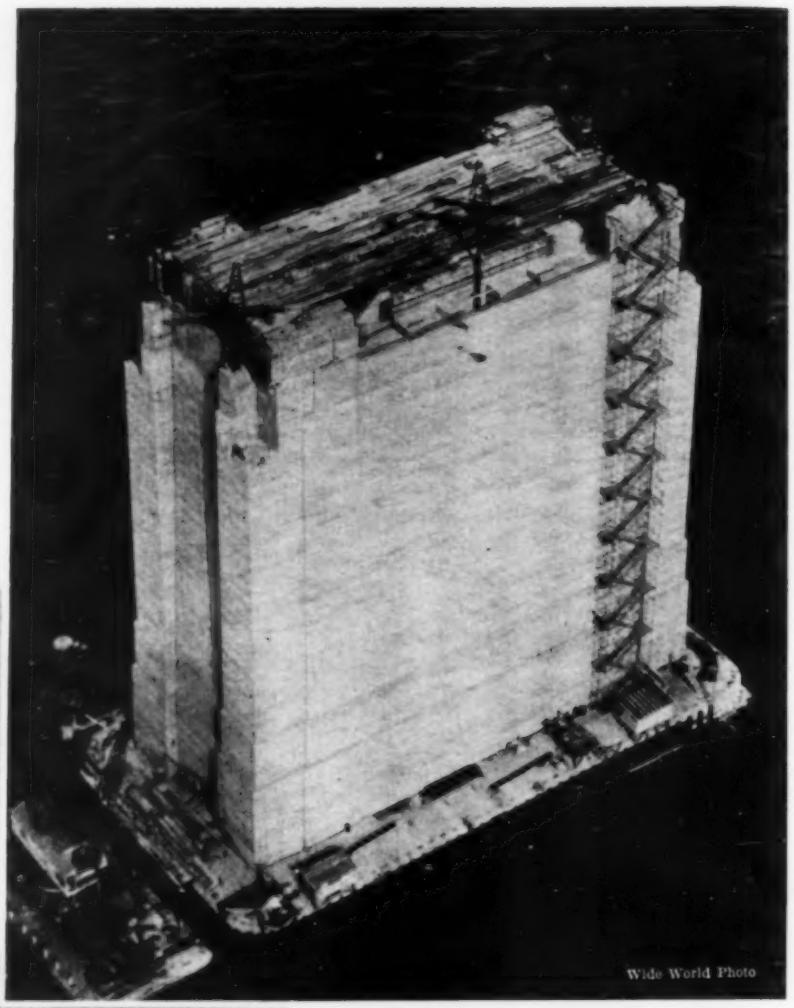
TWO hydraulic giants that already had served their time in washing out gold-bearing gravels, now are at work on a highway grading job in Trinity County, Calif., involving the removal of about 6,000,000 cu.yd. of earth. The nozzles are 7 and 8 in. in diameter respectively and are served by a main pipe line 30 in. in diameter at the upper end, 26 in. lower down, with two 18-in. branches serving the giants. The total operating head is 550 ft. and the 8-in. giant uses water at the rate of 60 sec.-ft. The water supply is from a stream feeding a regulating reservoir of 600,000-cu.ft. capacity.

The water system and hydraulicking equipment were leased from the La-Grange Placer Mines, Ltd., owners of adjoining property. The large giant has been rated as averaging 800 cu.yd. per hour, the material moved being about 10.7 per cent of the volume of water used. In a normal year operation is expected for at least 75 per cent of the working season. It is thought that well over 1,000,000 cu.yd. of material will be moved in 1935. Operations will probably continue for four years, since the connections on either end of the highway, of which this grading job is a part, cannot be financed or constructed before the expiration of that period. California highway officials believe that this is the largest hydraulic operation yet undertaken on highway work.

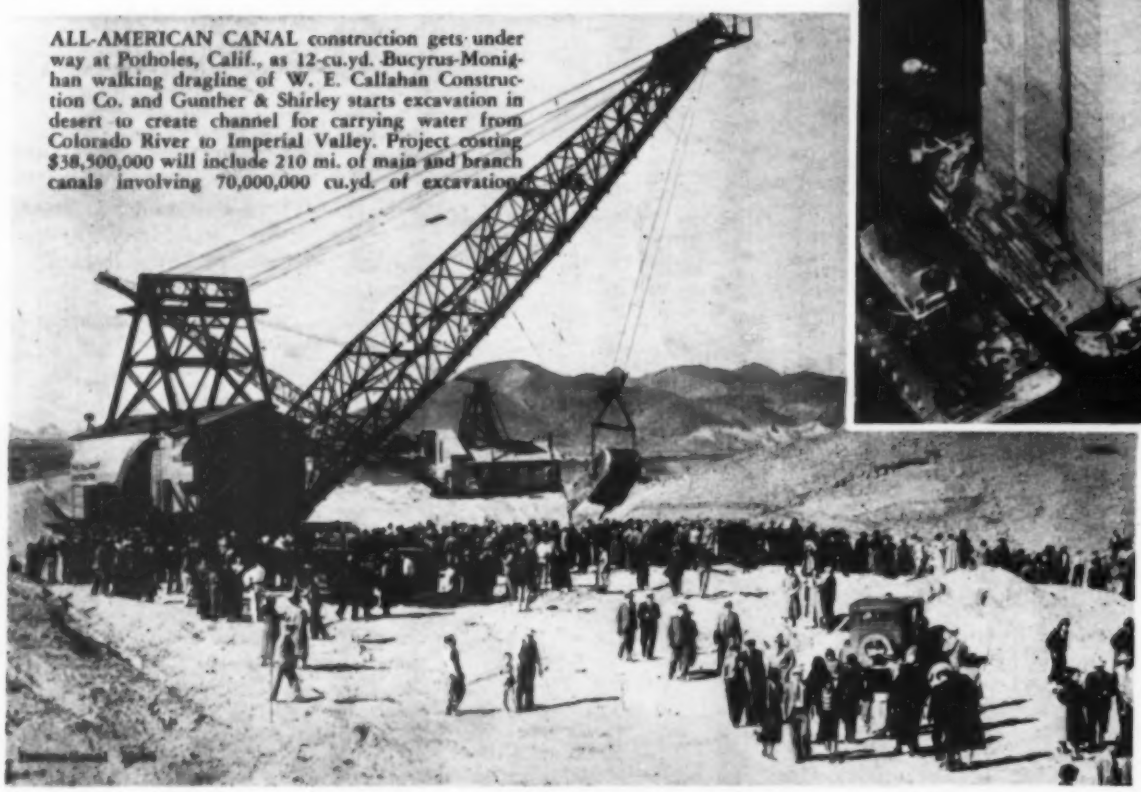
HYDRAULICKING EQUIPMENT *(above and left)* was formerly employed in mining gold-bearing gravel in Oregon Hill

This Month's

"NEWS REEL"



Wide World Photo

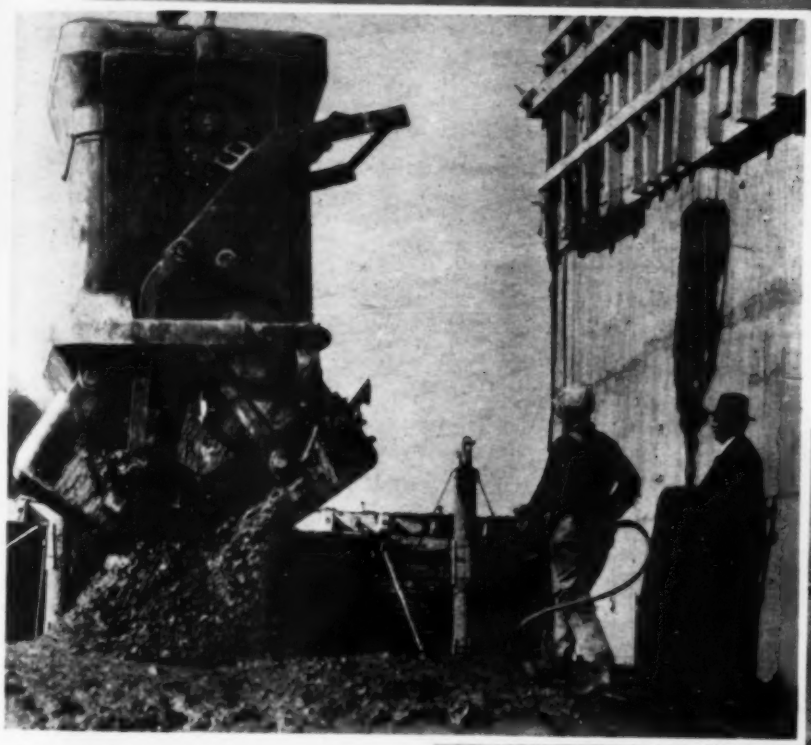


ALL-AMERICAN CANAL construction gets under way at Potholes, Calif., as 12-cu.yd. Bucyrus-Monighan walking dragline of W. E. Callahan Construction Co. and Gunther & Shirley starts excavation in desert to create channel for carrying water from Colorado River to Imperial Valley. Project costing $38,500,000 will include 210 mi. of main and branch canals involving 70,000,000 cu.yd. of excavation.

CENTRAL ANCHORAGE PIER for San Francisco-Oakland Bay bridge is massive concrete structure with base area of 92x197 ft. and height of 435 ft. from lowest concrete to base of steel superstructure of bridge. Pier is supported by unusual caisson substructure, sunk by excavating through 55 vertical steel cylinders each 15 ft. in diameter; outer ring of cylinders is filled with concrete. Superstructure of pier is hollow, with walls of reinforced concrete 12 ft. thick containing heavy structural steel members to transmit suspension cable stresses down into concrete structure. Center pier, built by Transbay Construction Co., is mid-channel terminus of two independent bridges each having a 2,300-ft. suspension span and two 1,160-ft. approach spans.

COFFERDAM is completed by Columbia Construction Co. for first half of $39,000,000 Bonneville dam and power project on Columbia River in Washington. Big walking dragline with 10-yd. bucket within inclosed area loads spoil into tractor-hauled 40-yd. Le Tourneau buggies. View looks downstream from Bradford Island side of main channel, with Washington shore in background.

GRAND COULEE DAMSITE on Columbia River in Washington, where construction of power development project is proceeding under $63,000,000 PWA allotment, is scene of activity in building of cofferdam along west bank by Mason-Walsh-Atkinson-Kier Co., contractors, under direction of U. S. Bureau of Reclamation, Frank A. Banks, construction engineer. Present program calls for a low dam (145 ft. high) of straight gravity type, 3,500 ft. long. Project involves 15,000,000 cu.yd. of excavation and 3,500,000 cu.yd. of concrete. Low dam is designed to facilitate possible construction of high dam (475 ft.) at later date. Dam will be built in three separate sections — west abutment, east abutment and center portion — with aid of steel sheet-pile cofferdams. Sheet piling extends along west bank of river for distance of 3,000 ft. About 2,700 men are now employed on the project.



CONCRETE PLACING ON NORRIS DAM half finished. Ross White, superintendent of construction for TVA on the job, *(at right)* watches the 500,000th yd. of concrete being placed in forms. Expectations are that the final 1,000,000th yd. will be in place by the end of the year. The project as a whole, including reservoir clearing, is 70 per cent completed. In recent months concrete has been placed at the rate of 80,000 yd. per month with three 3-yd. mixers.

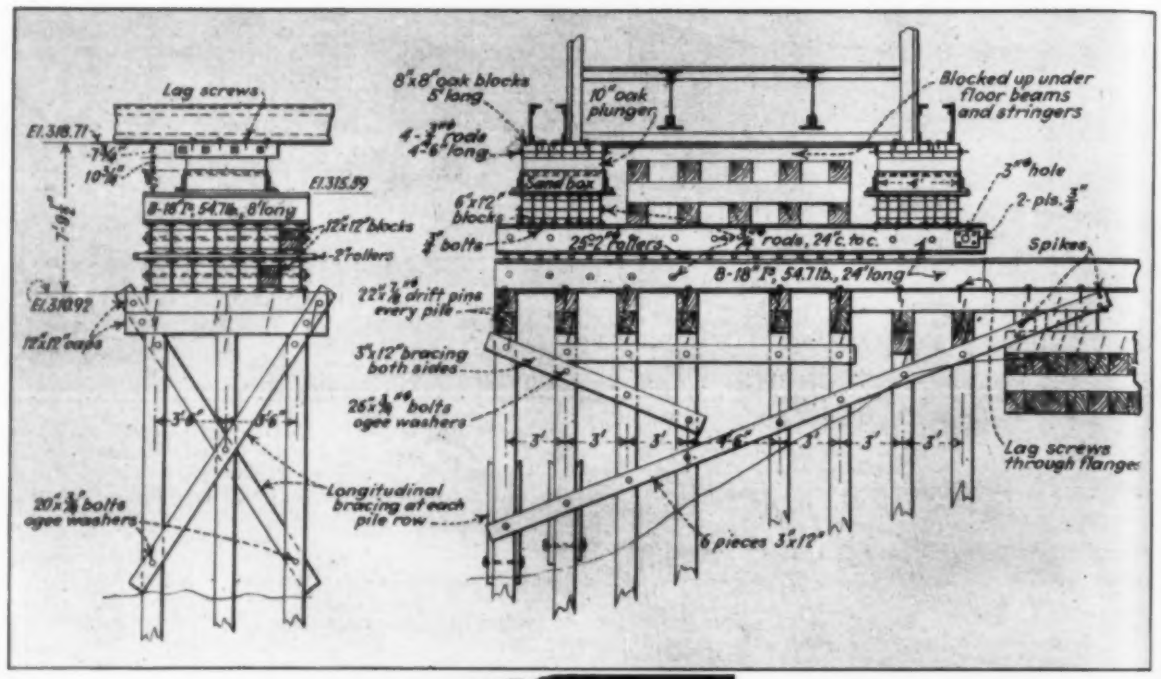
Wide World Photo

EAST BAY CROSSING *(right)* of San Francisco-Oakland Bay bridge is proceeding from Oakland (in background) toward Yerba Buena Island, where tunnel connects with West Bay crossing via suspension spans. Traveling derrick erects structural steel for series of thirteen 288-ft. through truss spans joining 1,400-ft. cantilever span. The contracts for this portion of the work are held by Bridge Builders, Inc., (substructure) and Columbia Steel Company, (superstructure).

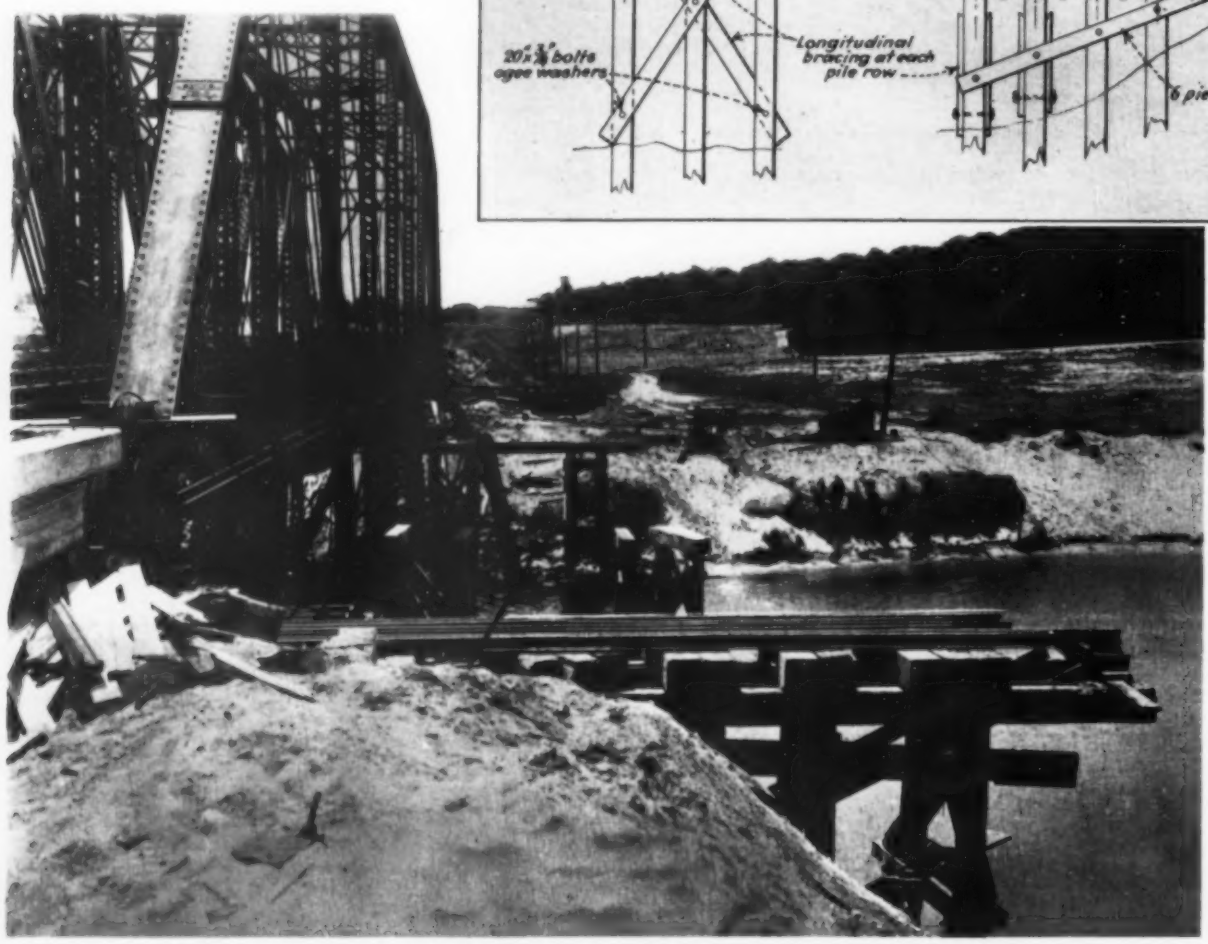
Old Railroad Bridge REPLACED IN 4 HOURS

IN A SINGLE moving operation the Faircroft Engineering Corp., of Brooklyn, N. Y., replaced a 200-ton Long Island R.R. bridge across the Shinnecock Canal at Hampton Bays, L. I., with an 800-ton structure designed to carry heavier locomotives. Four seven-part hauling ropes, operated by hoist drums, pulled the new span into position, pushing the old bridge out of the way before it. Both the old and the new span moved on steel rollers.

Within an allowable working time of 11½ hr. and an actual moving time of 4 hr., the Faircroft organization displaced the old single-track bridge, measuring 210 ft. in span length and 16 ft. between trusses, c. to c., and installed in the vacated position the new bridge, which has a span of 212 ft. and a width between truss centers of 19 ft. The trusses of the old bridge were pin-connected, with I-bar tension members. In contrast, the new bridge is a rigid structure, fabricated of rolled sections with riveted connections throughout. Part of the 600-ton increase in weight in the new span is accounted for by a concrete deck.



FRONT AND END ELEVATIONS of bent 2, on which one end of new bridge is rolled to final position. Grades and dimensions shown do not allow for camber.



LINES OF STEEL RAILS are laid on falsework bents at both abutments to carry old bridge clear of its position as new span moves in to replace it.

Engineers of the Long Island R.R. Co. decided that placing the new bridge on the existing abutments was more economical than constructing new abutments and changing the alignment of the track. To provide the required channel clearance under the new bridge, it was necessary to raise the track level 20 in.

Raising Old Span—Between trains, the old bridge was jacked up 20 in. and supported on wood cribbing on the abutments. To relieve the horizontal thrust on the abutments, the approaches to the bridge were placed on reinforced concrete girder spans, resting on concrete piles. During the construction of these approaches, the track was supported on timber cribbing. All trains proceeded through the project under slow orders.

Erection of New Bridge—A drawing accompanying these notes shows the falsework on which the new bridge was erected alongside the old. Two pile bents were constructed with 60 ft. of clear channel between them. On the bents, the Sayre Steel Construction Co., Inc., of New York City, steel erector, placed two 86-ft. girders with cross-beams at panel points to support three panels of the bridge. Starting at the east end, this firm placed the bottom chords and floor system to the west abutment and then erected the web members and top chords.

Time Limitations—Actual removal of the old bridge and installation of the new were scheduled for a Saturday evening during the summer of 1931. The bridge was closed at 7:30 p.m., after the last passenger train for the day had passed. All work had to be completed by 7 a.m. Sunday, in time for the

first passenger train of the morning. In this allotted period of 11½ hr. the contractor had to remove the old structure from its temporary timber crib abutments and seat the new bridge in permanent position on the masonry abutments.

Preliminary Work — In preparation for moving the new 800-ton span, falsework bents were erected under the first panel points at the two ends. These bents consisted partly of wood piles, cross-braced and capped with heavy timbers, and partly of timber cribbing. On the caps of each bent were laid eight lines of 18-in. 54.7-lb. I-beams separated by 12x12-in. timber blocks and bolted together with ¾-in. rods on 2-ft. centers. The length of the bent, measured transversely to the bridge, was about 50 ft., sufficient to permit rolling the new span a distance of 21½ ft. from its erected position to its permanent position.

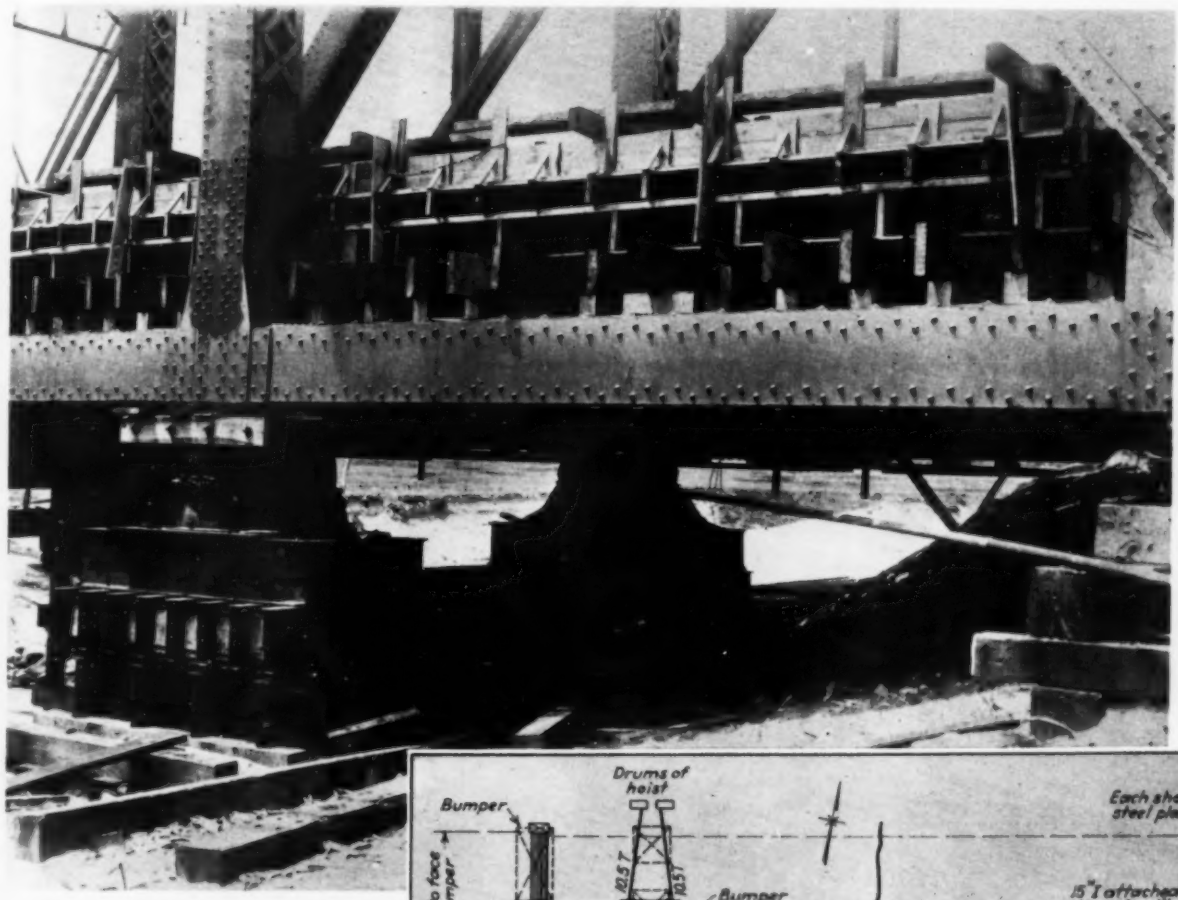
A series of 25 solid steel 2-in. rollers 9 ft. long, placed between the lower I-beam grillage and an upper set of I-beams, 24 ft. in length, served as the rolling mechanism on each bent. The upper set of I-beams supported a grillage of eight 18-in. I-beams 8 ft. long and a sand jack 4 ft. in diameter under each of the two trusses of the bridge. Between the sand jacks, the floor beams and stringers of the bridge were blocked up on timber cribbing from the upper set of I-beams resting on the rollers. The rollers were spaced and held in position by spacing bars, consisting of 4x6-in. angles with 2½-in. holes drilled on 12-in. centers in the 6-in. leg.

Sand jacks were selected as the most easily controlled means of lowering the 800-ton bridge upon its foundations. Four of these jacks were used, one under each truss on each of the two bents. The sand boxes, made up of ½-in. steel plate, were 4 ft. in diameter and 20 in. deep. Close-fitting circular plungers of oak, 10 in. deep, rested on the sand in the box. The outlet for the sand was a hole burned in the bottom of the box at the time of lowering the bridge.

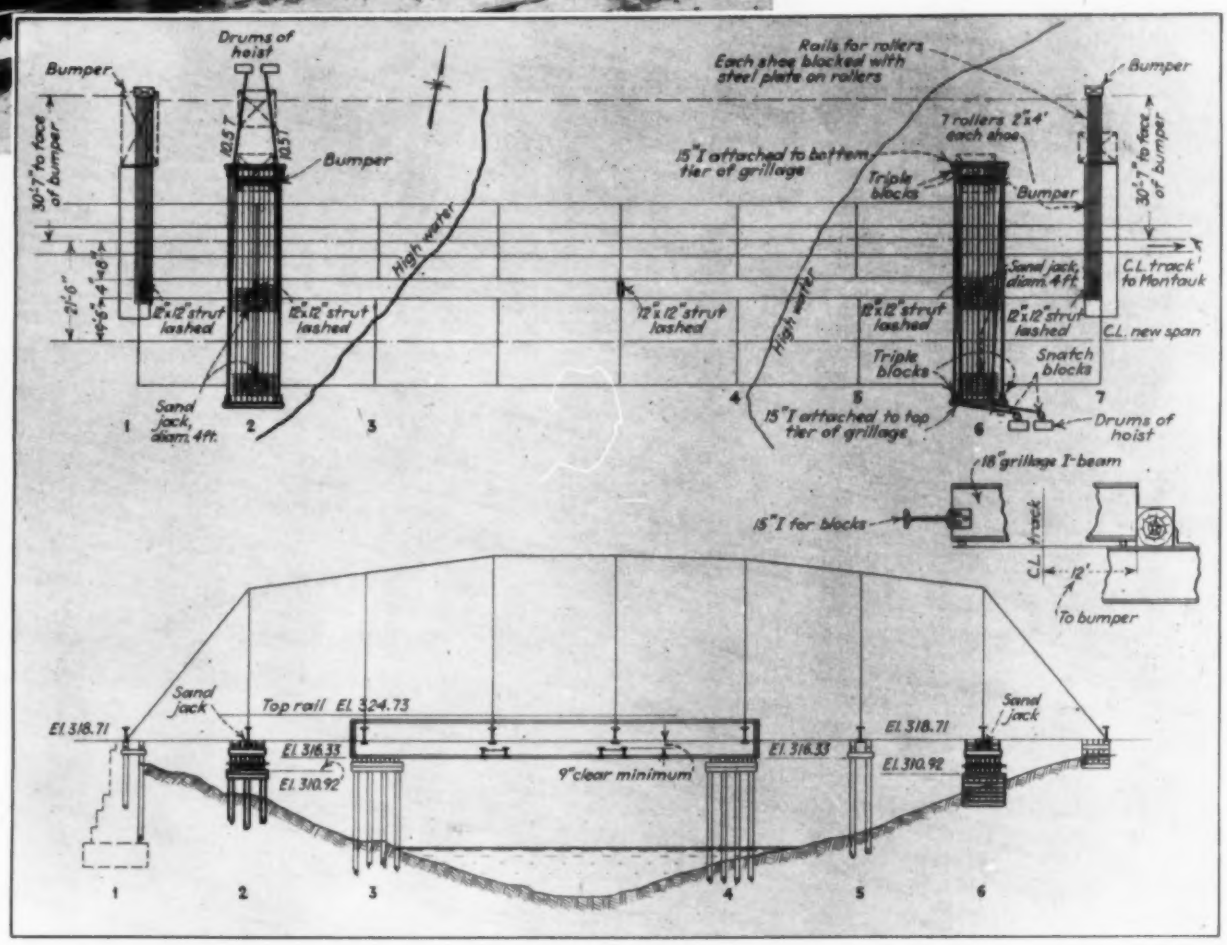
On the clear side of the old span, the contractor built up bents and timber cribbing beyond the abutments and placed six lines of steel rails to carry the structure during and after displacement. Laying of rails under the bridge itself had to wait until the railroad track was closed to traffic.

To unite the two bridges for simultaneous movement, the adjacent trusses were lashed together and struts were placed between the bottom chords at the abutments, at the first panel points, and at the center of the span. These struts were 12x12-in. timbers intended to absorb the impact if the bridges reached the bumpers at the end of their tracks too suddenly. Wood bumper blocks were fastened near the ends of the lower I-beam grillages supporting the new span.

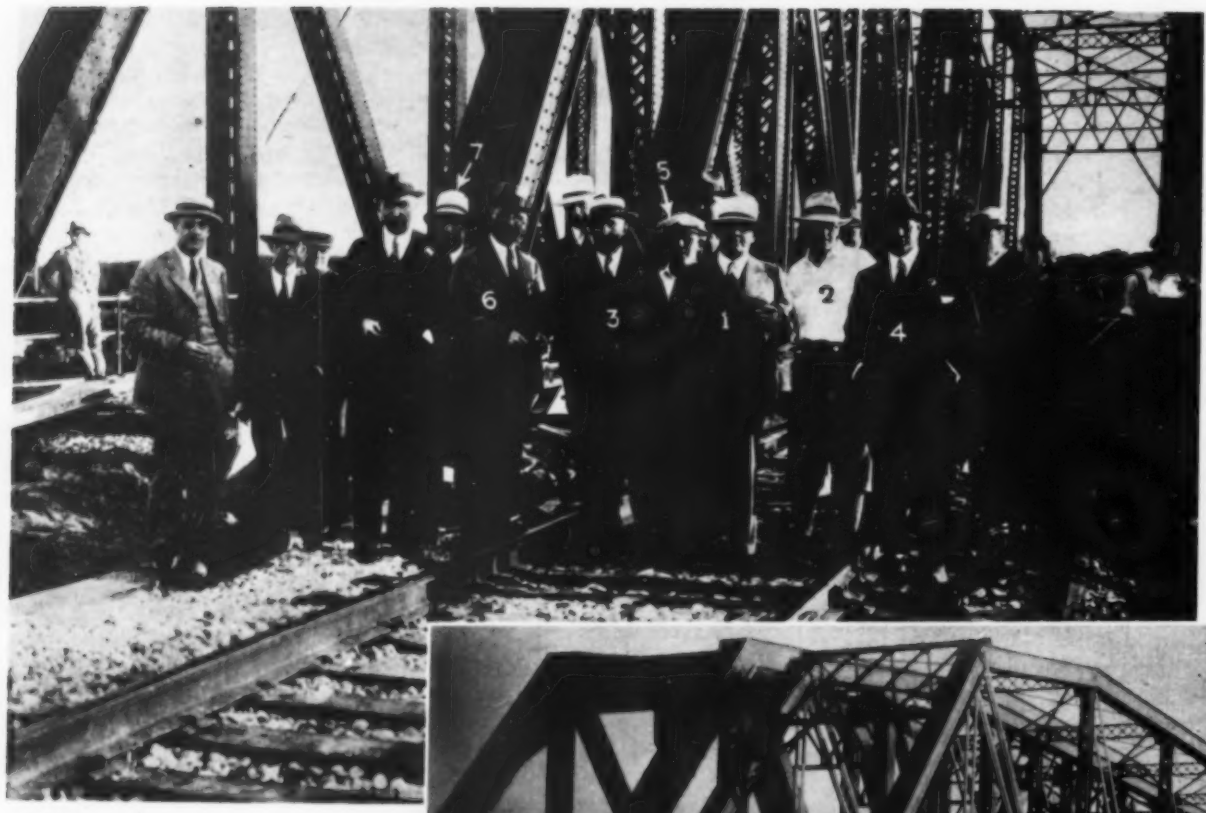
Two Lidgerwood 86-hp. double-drum gasoline hoist engines supplied the power for moving the two spans. A hoist engine was placed on the ground near each of the bents carrying the new bridge. From each hoist drum a line was reeved through a set of three-sheave blocks, one block being attached to the fixed I-beam grillage under the rollers and the other to the movable grillage on top of the rollers. A total of four seven-part hauling lines thus was available for the moving operation.



NEW SPAN rests at two panel points on pairs of sand jacks supported by tiers of I-beam grillages. Steel rollers between two lower tiers of parallel I-beams are held in position by angle-iron spacing bars.



PLAN AND ELEVATION of falsework used in erecting new bridge and in moving old and new spans simultaneously. Steel-cable hauling ropes reeved through triple blocks provide four seven-part lines for moving two bridges in unison. To maintain 60-ft. clear channel opening during erection of new bridge, three panels are erected on temporary girder span between two pile bents.



IN CHARGE OF OPERATIONS *(left)*. **(1) E. W. Foley, president, and (2) E. W. Young, superintendent, Faircroft Engineering Corp.; (3) P. F. Sayre, president, (4) Walter F. Barker, vice-president, and (5) Horace Stetler, erection superintendent, Sayre Steel Construction Co.; (6) H. T. Gifford, assistant engineer, and (7) J. M. Fair, division engineer, Long Island Railroad.**

The contractor estimated that each of the drums could be counted upon to exert a force of 1½ tons, giving a total pull of 10½ tons for each of the four seven-part lines, or 42 tons in all.

Moving Operations—After the last passenger train had crossed the bridge, the contractor jacked up the two ends of the old span and placed two sets of steel rails, with 2-in. solid steel rollers 4 ft. long between them, on each abutment; the lower grillage of steel rails was connected with the six lines of steel rails already laid on the bent previously constructed. The actual rolling of the spans into their new position proceeded in moves of 2 ft. each. Men at the two ends of bridge signalled their hoist operators to stop when the structure reached the limit of each 2-ft. move as indicated by 6-in. marks on the I-beam grillages. After bearing plates had been placed on the abutments under the shoes of the bridge, the span was lowered into permanent position by discharging sand from the sand jacks. The entire operation of replacing the old span with the new was completed at 11:33 p.m., just 4 hr. after it was started.

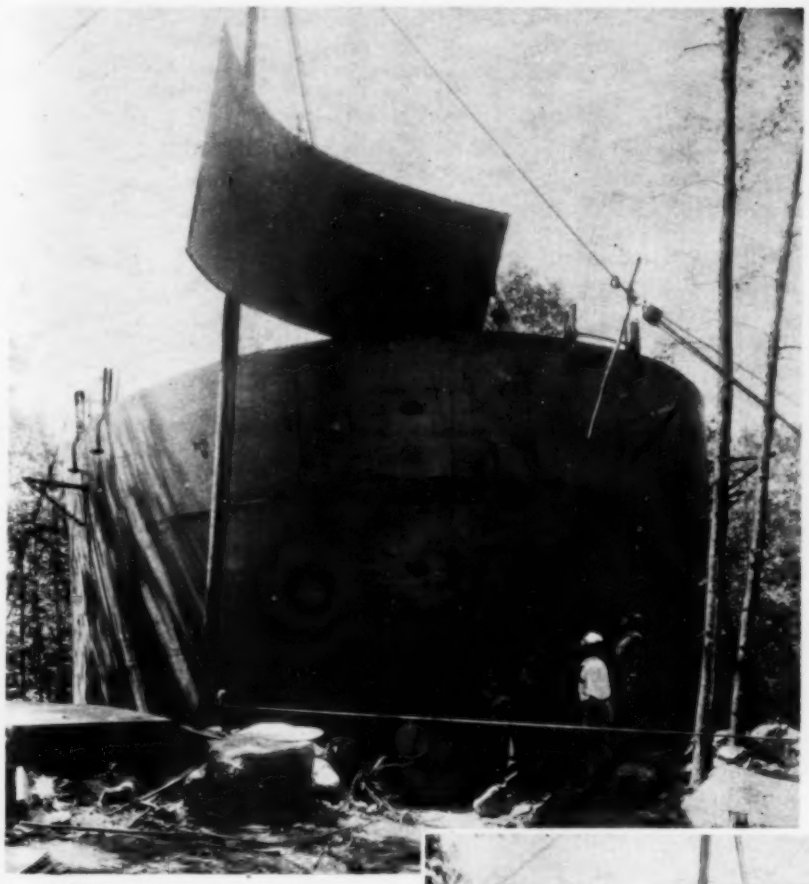
LAST TRAIN *(above)* **crosses old bridge at 7:30 p.m. on a Saturday evening in June. WHILE SUMMER DAYLIGHT LASTS** *(left)* **old span moves out and new bridge replaces it on existing rebuilt masonry abutments.**

Administration—Under W. E. Foley, president, the work was directed for the Faircroft Engineering Corp., by E. W. Young, superintendent, and W. M. Miller, engineer. Horace Stetler was in charge of steel erection for the Sayre Steel Construction Co., Inc., of which P. M. Sayre is president. For the Long Island R. R. Co., George Patton, assistant chief engineer, H. T. Gifford, assistant engineer, and J. M. Fair, division engineer, were in charge.

STORAGE TANK

for Community Water Supply

ELECTRICALLY WELDED

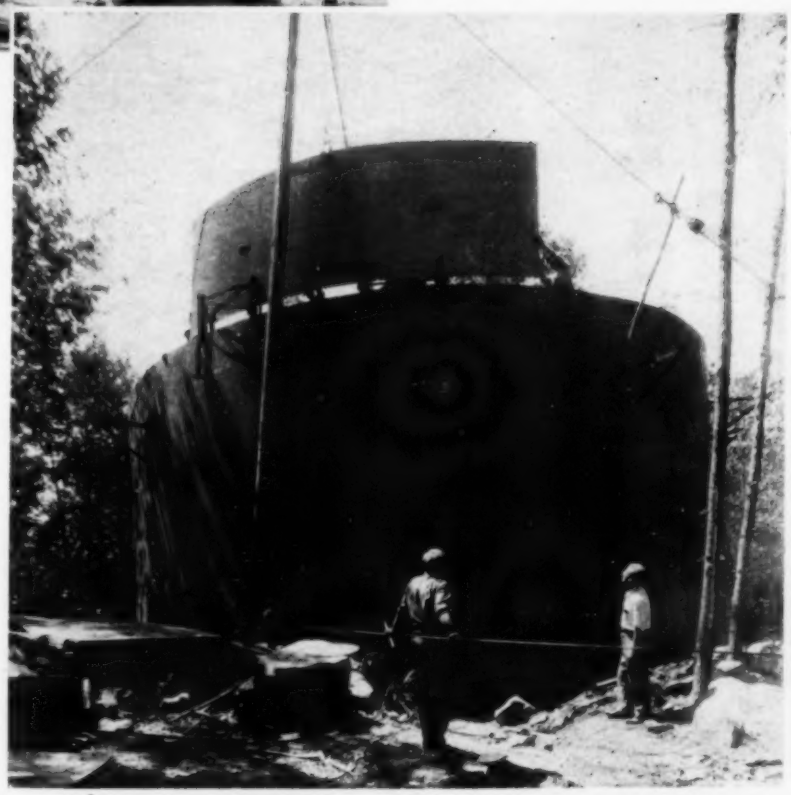


GIN POLE raises 1-ton plates from ground to upper rings of tank.

ELECTRIC WELDING fuses watertight joints between plate sections of new storage tank at Lake Mohawk, N. J.

TO meet the potable water supply need of an expanding real estate development at Lake Mohawk, Sparta, N. J., the Dover Boiler Works, of Dover, N. J., erected an electrically welded storage tank of 364,320-gal. capacity for the Arthur D. Crane Co. The local community, situated within a 2,300-acre reservation about the shores of a 3½-mi. lake, consists of 530 homes, four restaurants, two hotels, business center, golf course and clubhouse. Nearly every home has lawns and gardens which increase the demand for water.

Water is supplied from four artesian wells. Below the dam which impounds the lake are three wells delivering 205 g.p.m. A fourth well at the southern end, 2,000 ft. from the new tank, provides 530 g.p.m. The mountainous terrain around the lake makes two pumping levels necessary. Two booster pumps powered with 30-hp. motors and rated at 180 g.p.m. were installed in the line 300 ft. higher than the wells to supply 80 houses at Els. 773 to 1079. The line serving the upper level is a branch of the lower and is wholly dependent on the latter's reserves.



TRAVELING CARRIERS on tank wall transport plate section to position for welding.

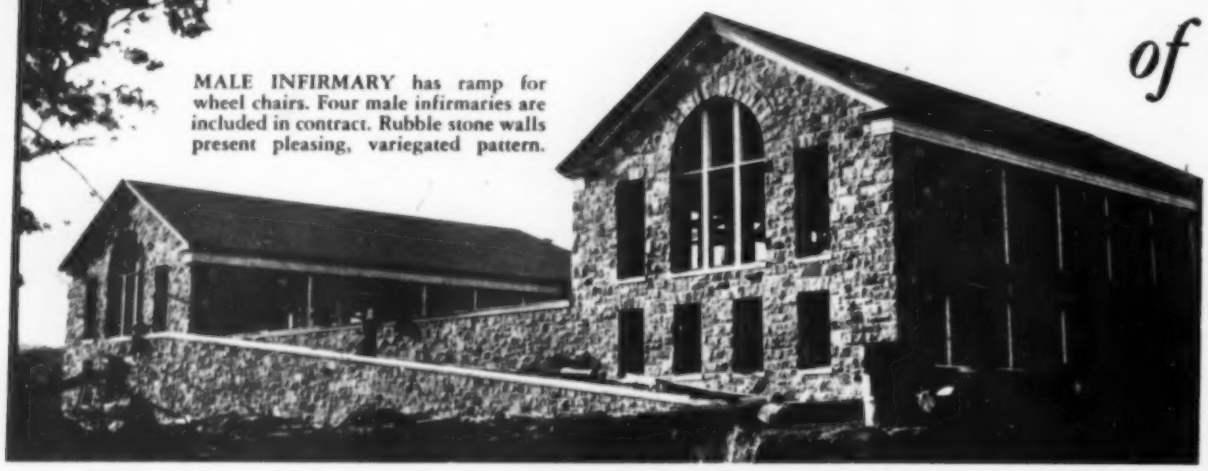
Prior to construction of the new storage tank, a pump fed 180 g.p.m. at 140-lb. pressure directly into a 6-in. main 3½ mi. long. Water from this main was stored in two tanks of 258,000-gal. capacity set at a base elevation of 910.4. To avert danger of water shortage, some way had to be found to deliver the maximum capacity of the well and its pump, which was 350 g.p.m. at 100-lb. pressure.

It was decided to erect an electrically welded tank at a point 2,000 ft. from the pump to provide 6-ft. greater total head than the other two storage tanks. A site for the tank was selected at the crest of a rock ledge on a mountain. Excavation was made to a diameter of 45.6 ft. and a depth of 3½ ft. to El. 910.4. A 1-ft. earth fill raked free from stones and tamped provided a smooth cushion for the base. To transport materials to the site, it was necessary to cut 1,000 ft. of road through the rock outcropping. Sections of the tank weighing 1 ton each were hauled over this road and welded on the ground.

Lake Mohawk now has an adequate water system equal to that of many small cities. Seventy-five fire hydrants, located at 1,000-ft. intervals, protect the reservation. The system has earned the community a classification of EE by the Schedule Rating Office, of Newark, N. J.

TRUCK MIXERS

Distribute Concrete to Scattered Buildings of Hospital



MALE INFIRMARY has ramp for wheel chairs. Four male infirmaries are included in contract. Rubble stone walls present pleasing, variegated pattern.

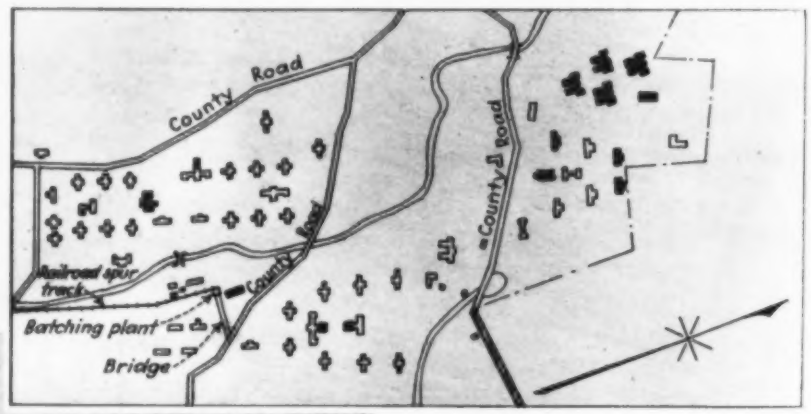
BENJAMIN DOKTORICH *(left)*, chief engineer, and A. J. CLEMENTE, president, Clemente Contracting Co.

A CENTRAL BATCHING PLANT and three 4-yd. truck mixers furnished the concrete and mortar for a widely scattered group of buildings which the Clemente Contracting Co., of New York City, recently completed for the New York State Department of Mental Hygiene, under the direction of the State Department of Public Works, at Letchworth Village, near Thiells, N. Y. New buildings, additions, and numerous sections of steam tunnel, called for in the contract, required a total of more than 13,000 yd. of concrete The structures are distributed over an area about 1 mi. by ½ mi. in area.

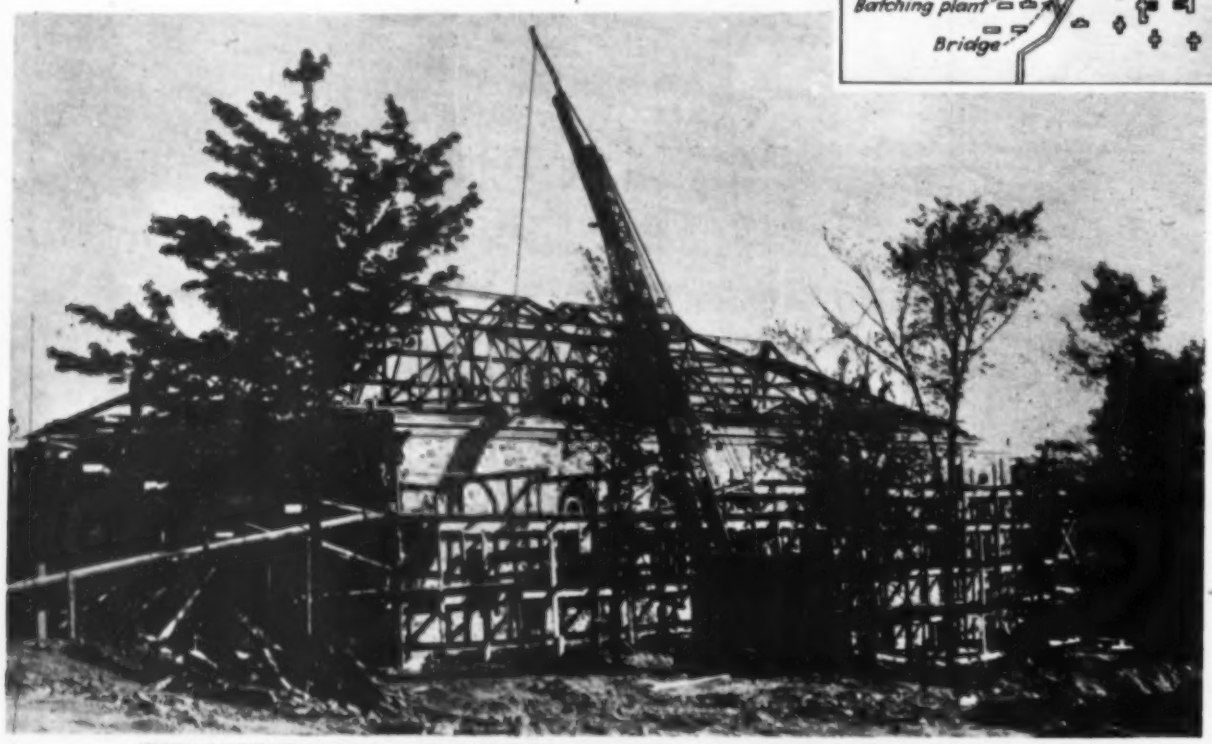
Letchworth Village is a rural hospital consisting of infirmaries and orher buildings necessary for taking care of mental defectives under the most favorable conditions. The Clemente contract provided for the erection of eleven buildings and four additions and for the construction of reinforced-concrete steam tunnels connecting the new buildings with existing tunnels. All the buildings rest on concrete footings on good gravel foundations. The walls are faced with rubble stone masonry (the stones for which were broken from boulders gathered on the property) backed with brick.

Construction Program—Starting operations in the early fall, the contractor planned to complete the foundations rapidly in order to leave as much time as possible available for the slower work of erecting the stone masonry walls. In accordance with this plan, a concrete plant was designed which could provide concrete in sufficient quantities to insure completion of the foundations at an early date. Concreting of foundations and tunnels was carried on whenever possible through the winter, salamanders and canvas housing being used to protect the concrete. In the coldest part of the winter, the contractor performed the excavation and concreting of the steam tunnels.

A flexible concrete plant, capable of delivering to a number of widely scattered locations in one day, was determined upon as the most economical solution of the concreting problem. Either central mixing or truck mixing would have provided the desired flexibility in delivering to various points, but truck mixers had the advantage that they could hold dry batches in their drums and delay mixing until such time as the concrete was needed. Three Rex 4-yd. Moto-Mixers provided both the necessary flexibility for widespread distribution and the capacity for rapid construction of the foundations.



PLOT PLAN of Letchworth Village, rural hospital of New York State Department of Mental Hygiene. New buildings and additions are indicated in black. Plan does not show hospital's private roads leading to various building groups.

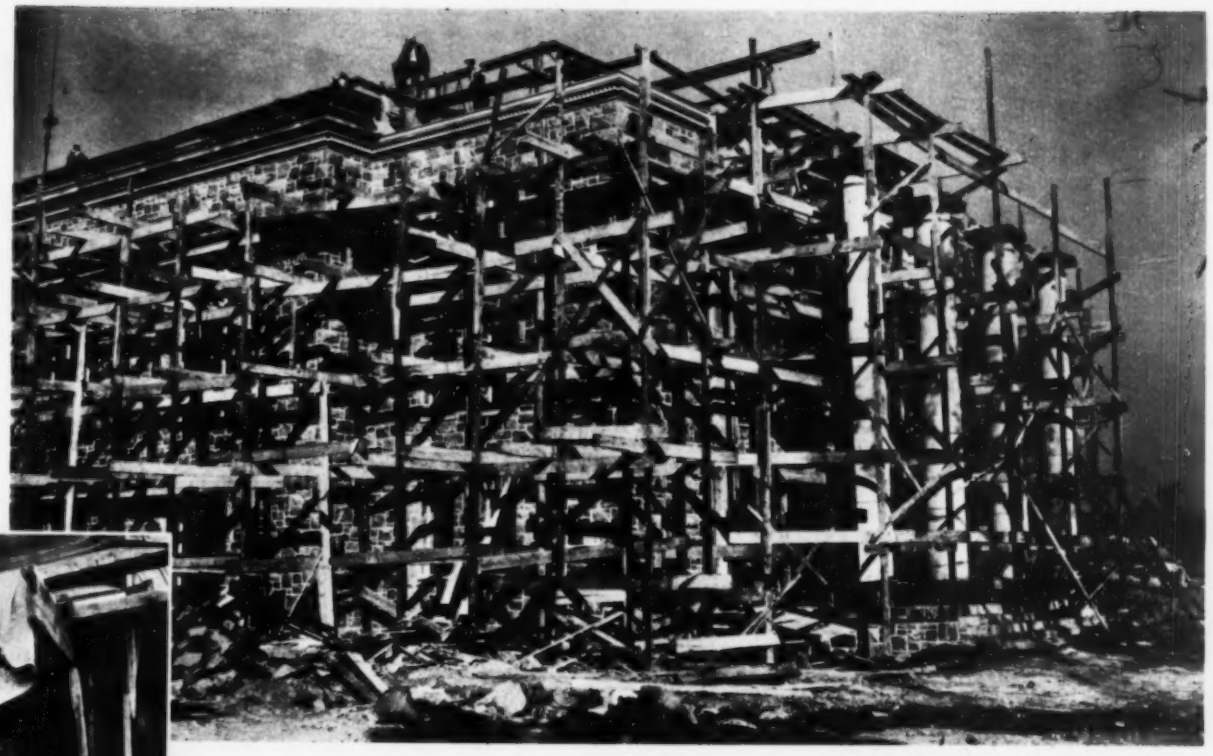


STEEL ROOF TRUSSES over assembly hall are erected by crane with 45-ft. boom extended to 60 ft.

As indicated by the accompanying plan, one railroad spur track serves Letchworth Village. To take advantage of a saving in using bulk cement de-

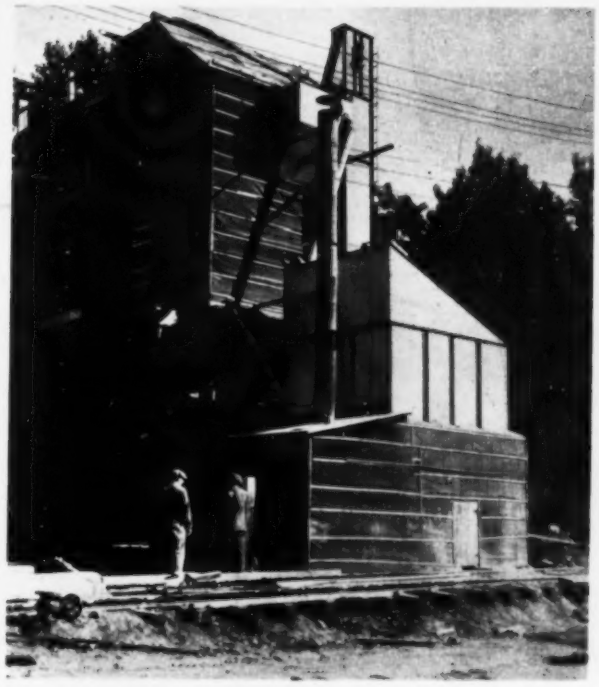
livered by rail, the contractor located the batching plant adjacent to this spur. Sand and gravel were delivered by truck about 4 mi. from the plant of Kehon Bros., at Haverstraw. The location of the batching plant, at the foot of a slope on the upper side of the spur track, offered an opportunity for delivery of aggregates by truck directly to overhead bins. A timber and steel bridge was built to connect a highway above the plant with the aggregate bins. Sand and gravel trucks backed over this bridge and dumped their loads directly into the bins.

A Butler bulk cement plant of 300-bbl. capacity transferred cement from



WOOD POLE SCAFFOLD serves construction work on exterior walls and portico of assembly hall.

TRUCK MIXER batched at central plant distributes concrete to various structures scattered over large construction area.



CENTRAL BATCHING PLANT to charge truck mixers is erected alongside railroad spur to permit rail delivery of bulk cement.

a track hopper by screw conveyor to a bucket elevator which raised the material to an overhead bin feeding the cement-weighing batcher. An overflow pipe from this bin discharged excess cement into the main cement storage bin. Sand and gravel were stored in Butler steel bins of about 45-yd. capacity and were measured by weight in Butler batchers.

Although a mixing and distributing plant of large capacity was required for the operations, the work was of such a nature that it never was possible to take the full output of the plant. The three 4-yd. truck mixers placed as much as 220 yd. on some days, but an average day's concreting required only 100 to 125 yd.

When delivering to the tunnels and foundations, the trucks usually discharged directly into the forms. The foundations were the largest item in the concrete construction, requiring 5,930 yd. Basement floor slabs and other slabs on earth called for 1,840 yd., and the quantity in the tunnels was 2,024 yd. The tunnel sections, which were square in cross-section, with inside dimensions of 6x6 ft. and reinforced-concrete walls 8 in. thick, aggregated 2,700 ft. in length.

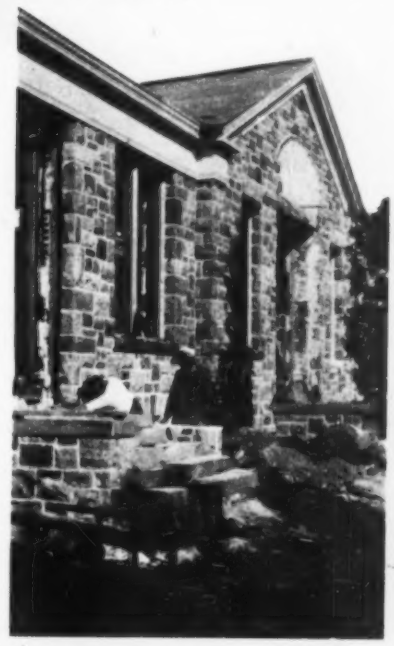
Structural concrete, used principally in the T-beam floors of the buildings, amounted to 3,414 yd. Concrete for the upper floors was discharged by the truck mixers into a 1-yd. bottom-dump bucket which was hoisted by a crane. The crane either placed the concrete directly or discharged it into a floor hopper for further distribution by hand carts.

In addition to the concrete, the batching plant and truck mixers prepared the lime cement mortar for 180,000 cu.ft. of rubble stone masonry, 750,000 common brick, and 75,000 face brick. The stone masonry required about 2,200 yd. of mortar, and the brickwork demanded about 440 yd. Lime putty for the mortar was mixed by hand in large pans on an upper platform at the batching plant and was shoveled into the charging hopper, was added.

where the correct proportion of sand

Rubble Masonry—A feature of the construction of the buildings is the rubble stone facing of the walls. Many varieties of granite boulders were deposited by glaciers in the vicinity of Letchworth Village, and these boulders, when broken and placed in a rubble masonry wall, present a pleasing, variegated pattern of contrasting colors which blend into an artistic whole. Larger boulders first were broken with pneumatic drills, operated by portable compressors; but all chipping was performed by hand.

Supervision—For the Clemente Contracting Co., the work was directed by A. J. Clemente, president; G. Clemente, treasurer, and Benjamin Doktorich, chief engineer. Charles W. Lyle, superintendent, was in charge at the site. For the State Department of Public Works, which was responsible for the design and construction of the buildings, Frank J. Honan, senior superintendent of works, supervised all operations in the field.



HIGH-QUALITY WORKMANSHIP produces attractive rubble masonry walls laid up with stone broken from boulders found at site of rural hospital.

RIVER PIERS AND COLUMN BENTS of Meramec River bridge, Missouri, rest on foundations of rolled steel H-section piles 40 to 60 ft. long driven to rock.

ROLLED H-SECTION PILES *for Bridge Foundations*

IN CHARGE AT SITE. J. G. Lester, project engineer for Missouri State Highway Department, supervises construction of bridge.

TIMBER GUIDE FRAMES at two levels in cofferdam spot piles in exact location and hold them vertical while being driven.

By J. G. LESTER

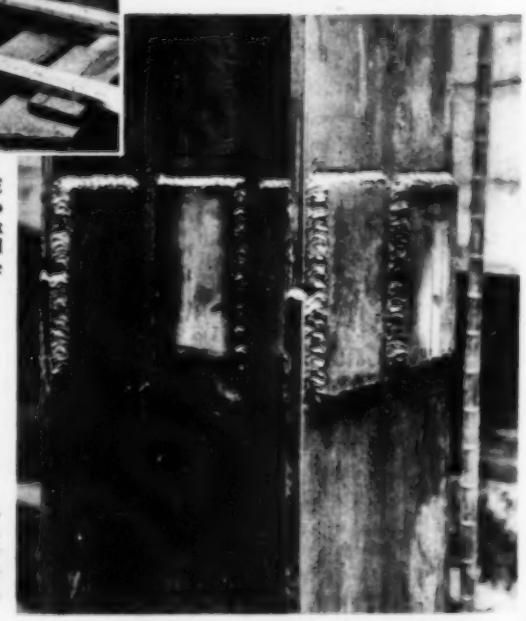
Project Engineer, Missouri State Highway Department

ROLLED STEEL H-beam sections for foundation piling are being used by the Missouri State Highway Department in the construction of bridges where foundation conditions are suitable for this type of support. The largest example of this type of construction to date is the Meramec River bridge on U. S. Route 61, about 10 mi. south of St. Louis. This structure replaced an old steel truss bridge which had been inadequate for some time to care properly for the heavy traffic on an arterial highway. The old bridge had a roadway width of 16 ft. with a pavement width of 18 ft. on each approach. In contrast, the new structure has a roadway width of 42 ft. and a pavement width of 40 ft. on the approaches — evidence of the present trend toward making bridges slightly wider then the road.

Bridge Dimensions—The new bridge, located on a 23-deg. skew, consists of two main river spans of 211 ft. each, flanked on each side by four 52-ft. I-beam approach spans, the total length of bridge being 845 ft. Each river span consists of two through Pratt trusses, with curved top chords, spaced 45½ ft., c. to c. Weight of structural steel in each truss is about 80 tons and in each complete span is 337 tons.

Substructure—Foundation conditions required either long piling or deep piers. Rock is about 60 ft. below water, with overburden ranging from fine sand to coarse gravel interspersed by layers of clay at irregular intervals. Bedrock (known as St. Louis limestone) is a hard dolomite capable of supporting heavy loads.

Reinforced concrete piers and abutments set on steel piling driven to rock support the bridge superstructure. A total of 457 foundation piles were used. The number per pier varies from a minimum of 18 in each approach bent to a maximum of 93 in the main river pier. Pile lengths ranged from 40 to 60 ft., depending upon location. In the main piers the center piles projected up



PILE SPLICE *(right)* incorporates twelve steel-plate straps electrically welded along all their edges to flanges and webs of abutting H-sections.

through the footings into the shafts; the outside rows were cut off 2 ft. above the seal course and the intermediate rows were cut off at various heights. In the approach bents all piles were cut off at an elevation 1 ft. above the top of seal course. Piles were spaced 3 ft., c. to c., in all footings, to give sufficient space for driving and for cofferdam braces. The static load on each pile is about 20 tons, and the total load (dead+live+wind) is about 30 tons.

Driving Piles—Rolled beams specified for the foundation piling were 10-in. 49-lb. H-sections. They were driven without point reinforcing. A special cast-steel driving head, shown in an accompanying photograph, was used to prevent battering the tops. Several piles driven at one of the piers were pulled to permit substitution of longer members, thus avoiding the expense of splicing. These driven points showed no signs of distortion or strain; they were redriven later with no difficulty.

Two checker-board templets, one at water level and the other at the top of the cofferdam, guided the pile setting, as indicated by a photograph. A long-boom crane handled the piles.

It was specified in the contract that the piles be driven with a hammer delivering an energy blow of at least 7,000 ft.-lb. To meet this requirement the contractor used both a National No. 1 and a McKiernan-Terry 9B2 with satisfactory results. Driving usually proceeded on all piles in each hole until they were level with the first checker-board; this templet then was removed and driving continued until all were level with the second board. After this guide had been removed the piles were driven to refusal. The method of spotting and supporting the piles in timber frames resulted in putting the heads of driven piles within 2 in. of designed location.

Refusal was determined by a penetration test outlined in the specifications: After a pile apparently had struck rock it was given 500 blows of the hammer preparatory to the refusal test; 100 blows then were given, and if the penetration did not exceed 1 in. under these 100 blows the pile was accepted. If the penetration did exceed 1 in., the 100-blow test was repeated until the required result was obtained. No serious difficulty was encountered in obtaining these results, and if the hammer was correctly placed on the cap no appreciable battering of the pile head occurred. Because it was impossible to determine beforehand the exact point of refusal, it always was necessary to cut off the top of each pile at the desired elevation before welding the cap in place. For convenience in handling both the pile and the cutoff the contractor burned a hole in the top of each pile before driving.

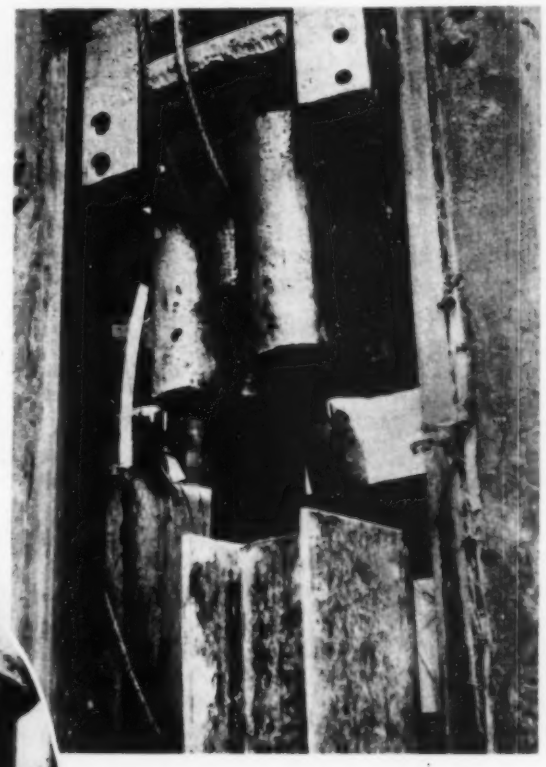
Pile Splices—To splice the H-section piling, an arc-welded splice was designed to develop strength in the joint equal to that of the pile. This splice consisted of four ⅜-in. steel plates on each flange and four ¼-in. plates on the web, welded with ⅜-in. and ¼-in. fillets, respectively, around the entire perimeter of the plates, giving a total of twelve plates and approximately 20 lin. ft. of weld to each splice. One of the photographs shows a completed splice. This type of splice also was used in building followers for driving piling under water. When carefully made, these splices withstood driving stresses for a large number of piles; but if undercutting occurred in making the welds the splice failed in time.

Pile caps were made from the cutoff ends of the driven piling. Each cap consisted of a piece of H-beam with one flange removed and a notch cut in the web to fit over the web of the pile, as shown in one of the photographs. The cap was placed on the pile and was welded with a ⅜-in. fillet along the upper corners and for a distance of 3 in. along each side of the toe of the cap.

Welding Tests—All welders were required to pass two qualification tests before being permitted to work on the job. A preliminary test of a horizontal fillet welding on two plates was given first to determine the welder's familiarity with the machine, material and welding rods being used. In his final test the operator made eight fillet welds in vertical position. The preliminary plates were broken apart on the job to determine the extent of any slag or gas pockets, the penetration of weld metal and the other items that constitute a good weld. Unless the welder passed this preliminary test he was not permitted to make the final test weld because of the expense involved in making and machining the second plate. The final plates were inspected in the field for surface appearance and if satisfactory were shipped to the State Highway Department's testing laboratory for a shear test. After the plates had been broken in shear the weld was inspected to determine the extent, if any, of gas or slag pockets and to study the penetration of the weld metal. Final approval of the welder depended upon the results of these tests.

All welding was done by the shielded-arc process, using covered uranium rods. Current was furnished by a portable gasoline-engine-driven generator capable of supplying four welders simultaneously. At first some trouble was experienced with low voltage at the electrode caused by excessive line loss in the small lead wires being used. This condition was corrected by substituting larger wires.

Personnel—NRH project 185A, of which this bridge is a part, was built with National Recovery Highway funds under the general supervision of the U. S. Bureau of Public Roads, Clifford Shoemaker, district engineer, and J. R. Quinn, bridge engineer. The work was directed by the Missouri State Highway Department, T. H. Cutler, chief engineer; N. R. Sack, bridge engineer; and P. H. Daniells, division engineer; with the writer as resident engineer in charge. A general contract was awarded to the Samuel Kraus Co., of St. Louis, which sublet the structural steel fabrication and erection to the Stupp Bros. Bridge & Iron Co.



CAST-STEEL DRIVING HEAD *(right)* fits over pile top and prevents battering.

PILE CAP *(in circle, below)* made from pile cutoff has slotted tongue which clasps web of H-section.

ARC-WELDED FILLETS *(below)* fuse cap to pile along horizontal and vertical contacting edges.

JOB MANAGEMENT
IN ROAD BUILDING

Second of Six Articles Dealing With Factors That Affect Equipment Selection, Operation and Dependability, Production and Cost

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.

—2—

Factors Governing High Production

IN the first chapter of this series, published last month, the daily cost side of production management was outlined and discussed at some length and a brief notation was made of the fact that the mechanization of construction has made fundamental changes in the management of construction work. These changes emanate from the fact that most of the work which is involved in construction is now done by machines of one sort or another. The nature of these changes and their proper influence on managerial practices are, then, of importance in a consideration of the fundamentals of modern construction management.

Reverting for a moment to the thesis established in the first article, it is evident that with a relatively uniform daily rate of expenditure on account of the work production involves, the amount of production each work dollar will buy must depend on the amount of production obtained each day. From this it follows quite logically that the means of maintaining a high rate of production must be of major importance in job management. The factors on which high production depends have been briefly noted in the preceding chapter and will now be discussed in more detail in the light of the modern conception of production management as a management of machines in which men are used to guide these machines and, in other ways, to assist in promoting their effective use, but not, as a rule, to do any major part of the work construction involves.

"Relatively few contractors secure 10 hours of work out of 10 ordinary working hours. Part of this loss is easily correctible. It involves lax practices in getting started in the morning and at noon and in stopping at night."

INTERDEPENDENCE OF EQUIPMENT must be recognized in "tooling" the job. A power shovel can maintain scheduled output only if the auxiliary haulage units are sufficient in number and size.

Operating Rate—The first essential in the management of a group of machines is the determination of the rate at which the most critically located machine will be operated. This machine will hereafter be termed the key producer. Usually it is the principal producing unit—as the mixer on a paving job or the shovel on a grading job. Incidentally, it usually is the machine around which the production organization is built. For many reasons it is not always essential that the selected rate of output be the largest of which the machine is capable. For lack of space these reasons will not be discussed here except to remark that a construction organization can be designed to work efficiently at rather widely different rates. The production per work-dollar spent cannot be held constant over this range, for equipment expense cannot, as a rule, be reduced as much as production is reduced when a low rate is selected. Still, with an organization designed for a given rate of output, even a good deal below the rate of which the key producer is capable, a fairly satisfactory production per work-dollar spent can be had, if the organization is designed to maintain that rate of output. It may, therefore, be accepted as a fact that the first consideration in the management of the production side of construction work is the selection of a rate of output for the key producer.

Maintaining Output—An important matter here is the selection of an operator for the key producer who can maintain this rate. The machine will do the work—if it is properly operated. There should be no temporizing at this point. If the shovel is to produce 1,000 yd. a day, the operator must be capable of operating it at that rate every hour in the day and every day in the week. To experiment with indifferent or poorly trained operators is to defeat the purpose of a planned rate of output.

The rate to be maintained having been determined and the validity of this rate at the key producer having been protected by employing a thoroughly competent operator fully capable of maintaining this rate, the second problem presents itself — the further validation of this rate by the development of an organization capable in all of its parts of sustaining it. We come here to the crux of the matter of organizing for production.

In the highway field, and again this is true in a great many other construction fields, production results not from a single operation performed by a single machine, but from a series of successive interdependent operations performed by machines in the hands of independent groups of operators. A simple but an entirely typical illustration is offered by a modern grading operation. A power shovel digs and loads the material that is being handled. Trucks or tractors with large wagons move it to the dump. A tractor pushing a bulldozer distributes it and rollers compact it in the fill. Here there are four successive operations and it should be—probably is—perfectly obvious that if the shovel is to produce 1,000 yd. a day, there must be enough trucks or tractors on the job to move this amount

"In general there has been far too much emphasis on labor as a factor in production cost and far too little emphasis on machines. High production and correct tooling are pretty nearly synonymous in modern highway construction."

of material to the dump, the bulldozers must be able to distribute 1,000 yd. a day, and the rollers must be able to compact this amount. In short, here, as in other types of highway construction, if a given rate of production is to be maintained, it is quite as necessary that other parts of the organization shall be able to support this rate as that the key producer shall be able to maintain it.

The fact that production is the result of a series of interdependent operations has been noted. Because the meaning the word "interdependent" is intended to convey may not be entirely clear, it may be remarked that, as here used, this term refers to the fact that the work which can be done by one machine depends on the proper functioning of some other machine or machines. In the illustration used above, the shovel is presumed to be able to move 1,000 yd. of material a day. It can do this only if the trucks or tractors can move that amount. Nor can the trucks move this amount unless the shovel can load it. These two operations are, then, fully interdependent. At the dump, the trucks cannot deposit material faster than the bulldozers will handle it. Here again there is complete interdependence, for the bulldozers in turn cannot spread 1,000 yd. of material a day unless the trucks deliver this amount.

SELECTION OF THE RIGHT MACHINES is only part of the story. Equally important is the choice of experienced machine operators.

"The first essential in the management of a group of machines is the determination of the rate at which the most critically located machine will be operated. This machine is termed the key producer."

Adequate Tooling.—These facts being accepted, it is evident that the organization of construction operations for production is not so much a matter of assembling men and training them to perform specific tasks as it is a matter of so "tooling" the successive processes by which production is had that a selected rate of output is mechanically possible. As noted above, this selected rate of output may be taken arbitrarily or it may be based on the capacity of the key producer—the mixer on a paving job, as an illustration. In the consideration of the tooling of the job the origin of this rate is not important. What is important is that such a rate shall be set and that the whole of the job—that is, all of the processes it involves—shall be tooled to it. In practice, it usually is desirable somewhat to over-tool subordinate processes. If this is not done a delay in any operation has the effect of stopping the job. Thus, if shovel capacity is 100 cu.yd. an hour and bulldozer capacity on the dump is exactly the same, stopping either the shovel or the bulldozer stops the job. However, if the bulldozer has a capacity of 125 cu.yd. an hour, it can be stopped for short intervals without delaying the job for its surplus capacity will enable it to catch up again after a delay. There is no fixed rule as to the amount by which subordinate processes should be over-equipped. A 10-per cent margin usually is sufficient, though a good deal more than this at times proves its value on critical subordinate processes, as at the crane on a paving job.

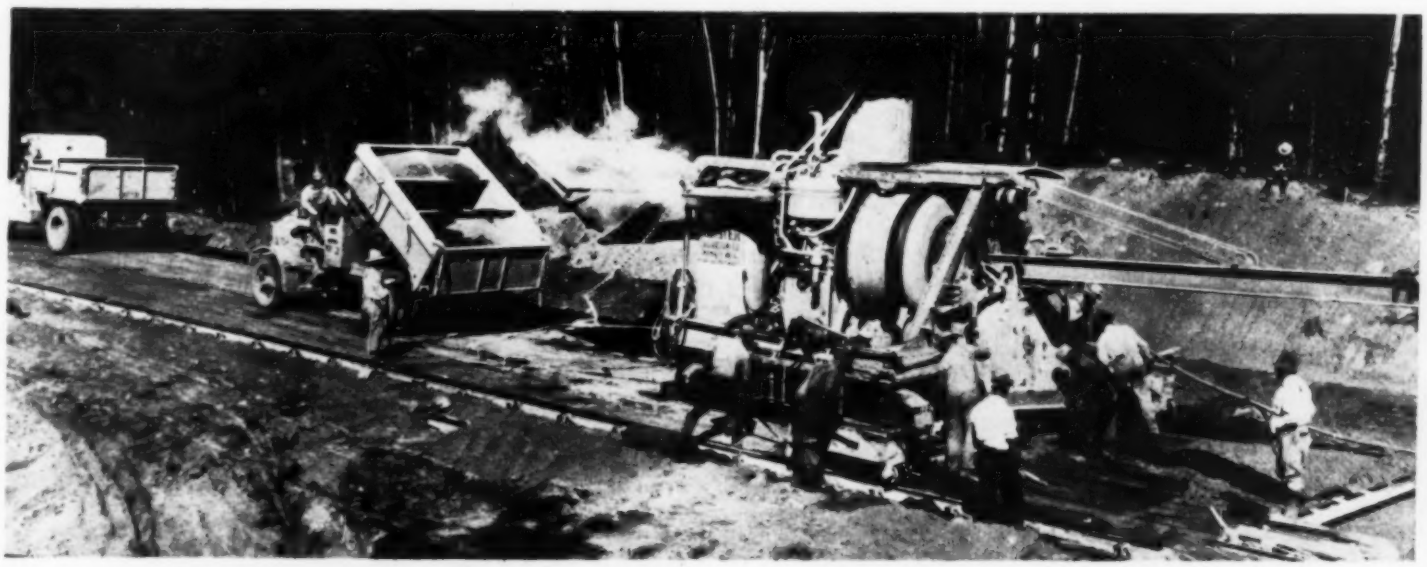
Under-tooling, in subordinate processes is common and, of course, absolutely fatal to production. It cannot be otherwise. If the asphalt plant will handle a 1-ton batch every 60 sec. but the sand dryer will only turn out 30 tons of sand an hour, it doesn't take much mathematics to prove that an output of 60 tons of asphalt an hour is a sheer impossibility. Under-tooling crops up in all sorts of places. The most amazing case which ever came to the writer's attention was that of a concrete paving job on which a batching plant had been installed that was patterned after the standard mine tipple. The fact that this device could not load a batch oftener than every 3 min. was a clear case of "under-tooling" an important operation.

Not very different in principle was the case of the man who bought a beautiful new 1¼-yd. shovel to replace a well-worn ¾-yd. machine and then complained bitterly to the writer that the new machine "didn't dig any more dirt than the old machine." He was perfectly right. It didn't! He was still using the old hauling equipment and he hadn't had enough of it properly to serve the ¾-yd. machine! Under-tooling — under-equipping — the hauling operation is very common throughout the construction field.

In asserting that the adequate tooling of the various successive operations or processes from which production results is a necessity if production is to move smoothly, it is assumed that these operations are understood and that their semi-independent status is appreciated. As the mechanization of construction has advanced the nature and the scope of these operations has become clearer. Nevertheless, it not infrequently happens that the scope of an operation or, more particularly, its nature as a distinct unit in the series of operations by which production is attained, is not at once fully apparent. As used in these articles, an operation (or a process) may be described as a detail which must be performed in connection with each unit of work completed. Normally each operation is performed by a machine (or machines) or by a distinct group of laborers, and it becomes highly important as an operation if it cannot be performed consistently hour after hour at a rate equal to the rate at which construction is scheduled to proceed.

"In the field of construction production results not from a single operation performed by a single machine, but from a series of successive interdependent operations performed by machines in the hands of independent groups of operators."

On a highly mechanized job the critical point in organization has been covered when the successive processes are properly tooled. On such a job, aside



THE KEY PRODUCER on a concrete highway project is the paving mixer. When the mixer stops, the job stops. Absolute mechanical dependability is essential to low production cost.

from necessary supervisory employees and the operators of the various machines, employment is negligible. Man power can, of course, be wasted here just as it can be anywhere else. Still, there is so little use to which extra men can be put on a fully mechanized job that the temptation to waste man power is slight. To have tooled such a job correctly is pretty nearly the same thing as to have organized it correctly. Incidentally, just here lies one of the great advantages of a high degree of mechanization. Once the various processes are correctly tooled (equipped) there is little chance for serious loss to occur because too much labor has been employed or because it has been poorly organized or badly handled.

On a partially mechanized job the proper tooling of all mechanical operations presents the same problem that is presented on a fully mechanized job. The mechanical equipment of each process must be such that it will support the planned rate of output. But partially mechanized jobs usually involve some processes which are not mechanized at all. Raking on a sheet asphalt job, subgrading, puddling and cement handling on a concrete pavement, are typical operations still widely handled on a hand labor basis. Where operations are performed by hand it is, of course, just as important that these shall be manned for production at the established rate as that mechanized operations shall be tooled for production at this rate. It is only when this is done, and done correctly, that the capacity for output at the planned rate is established. There is a good deal more opportunity to waste labor in operations executed on a hand-labor basis than on fully mechanized operations, for the number of men who can be used on or about a modern machine is strictly limited while the number required for a manual operation depends to a considerable extent on the efficiency of the supervision they are given. However, after allowing for the fact that labor may easily be wasted on manual operations, the fact remains that the expense of waste here is not likely to affect cost as much as it is affected by any failure to develop the proper capacity for output in a manually performed operation.

Time Losses—Finally, as to the production side of the daily expense—daily production relationships, it must be observed that a high rate of output also depends on the full utilization of the working day. It came as a surprise to the writer, and it may not be fully appreciated by others, that relatively few contractors obtain 10 hr. of work out of 10 ordinary working hours. Part of this loss is easily correctable. It involves lax practices in getting started in the morning and at noon and in stopping at night. Sometimes the principle machines are not "warmed up" and ready to function when the working day begins. Sometimes the early morning materials deliveries are not scheduled to reach the job at the proper time. There are a good many things of this sort which tend to subtract from the working day.

These things, and for that matter any job practice which cuts the actual working time of the important producing units by a half-hour or an hour each day—and larger losses in this field are by no means uncommon—correspondingly reduces daily production. This result is unavoidable. When a job is tooled and manned for a specific rate of production, it can operate at that rate, but it is not likely to be able to operate at a higher rate. Therefore, time lost in this way cannot be made up by increasing the rate of production. A man who rests for 5 min. can normally speed up enough to offset this loss of time. He is capable of working at various speeds and of temporarily increasing his work output above what he can do day after day. Some machines can be speeded up when conditions require. But as to a large organization, no such condition of flexibility of operating speed exists. It is tooled and manned for a given rate of output and this rate of output can be maintained. It is too cumbersome a thing to be "speeded up" for short intervals to catch up lost time. Therefore, for it, lost time and lost production become one and the same thing. For this reason the superintendent who would attain high production must take every possible precaution to insure the full utilization of the working day.

The concept of construction management is at least largely a matter of so tooling the successive interdependent construction processes from which production results that a predetermined rate of production is mechanically possible of attainment, after which the most important things are the protection of this rate by the employment of competent operators and the utilization of this rate during the whole of each working day, suggests two questions: What relation does labor have to this conception of production management? What relation does the dependability of equipment have to it?

The first of these questions may be answered by saying that on a highly mechanized job labor is largely a matter of men to operate the equipment. Competent operators understand the rate at which their machines can be operated under given conditions and can be readily given a working knowledge of the rate of production that is to be maintained. Such men generally understand their relationship to the production scheme and normally can be depended on to protect that relationship. For these reasons the problem of personnel for a highly mechanized job is largely the problem of selecting or training competent operators. If the job is correctly tooled it can hardly be incorrectly manned, for practically all of the men who can be used at all are those who are used on the machines.

This same statement applies to the mechanized operations on a partially mechanized job—as on a typical concrete paving job. The hand labor operations require more supervision and the labor used on such operations requires more training for, as a rule, such operations are handled by unskilled laborers. Nevertheless, even on jobs only partially mechanized, if the mechanized operations are tooled to a specific rate of production the "drive" that the machines generate in maintaining this rate tends to prevent laxity in the performance of the manually executed operations. True enough, if there is poor supervision over these manually performed operations, the effect will be to use somewhat too much labor here. Still, this is not as important from the cost standpoint as is a low rate of output.

CONTRAST IN METHODS. Hand labor *(right)* can move only a small fraction of the volume of subgrade material handled by the modern diesel-powered Caterpillar outfit consisting of an elevating grader and tractor-hauled wagons, in tandem, on crawler treads.

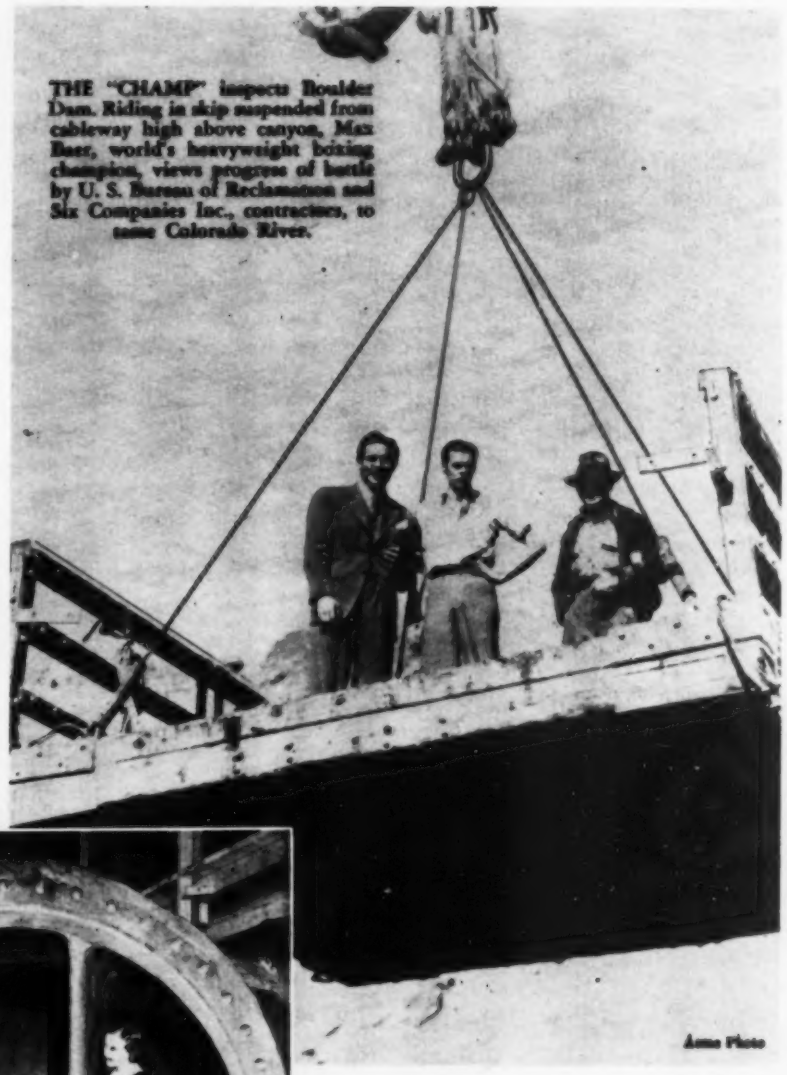
In general, the writer feels that there has been far too much emphasis on labor as a factor in production cost and far too little emphasis on machines. High production and correct tooling are pretty nearly synonymous in modern highway construction. Even the good old term "organization" has come to mean the proper selection arrangement and use of machines rather than the proper selection, arrangement and use of labor. Labor must still be used. It must still be carefully selected and properly trained. Labor can still be wasted by using too much of it, particularly on operations still performed by hand. The labor problem has not been taken out of construction work. Nevertheless, after admitting all of this, the fact remains that the organization of highway construction is dominantly the organization of construction equipment.

NEXT MONTH—Continuing this series on Job Management, Mr. Harrison will discuss in the May issue "Equipment Dependability."

JOB ODDITIES

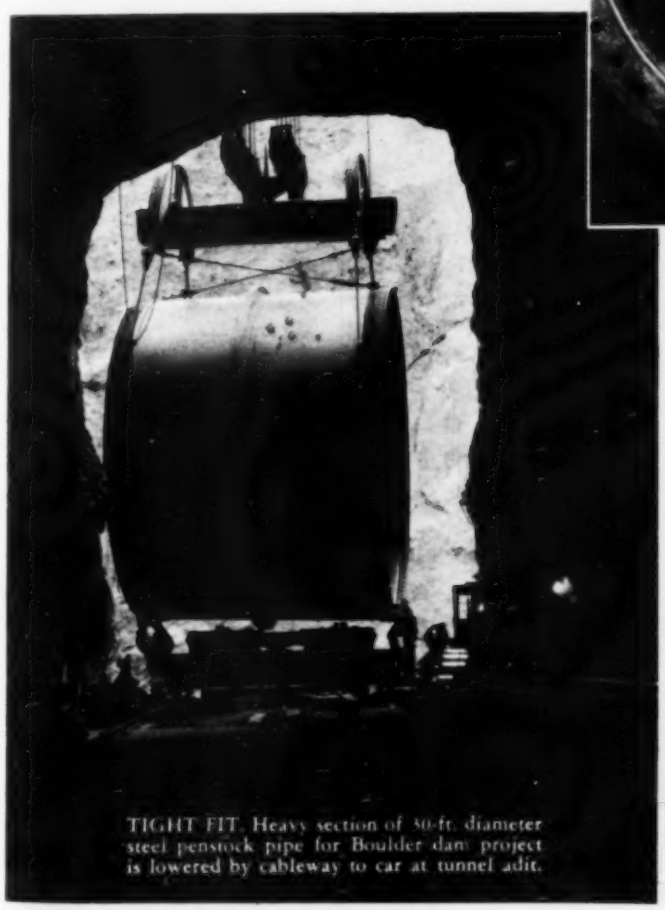
A Monthly Page of
Unusual Features of Construction

"HEAVY" CONSTRUCTION as it is done in England. Elephant "Dixie" helps lay electric cable in trench as part of improvement program at Whipsnade Zoological Park, country annex of London Zoo.

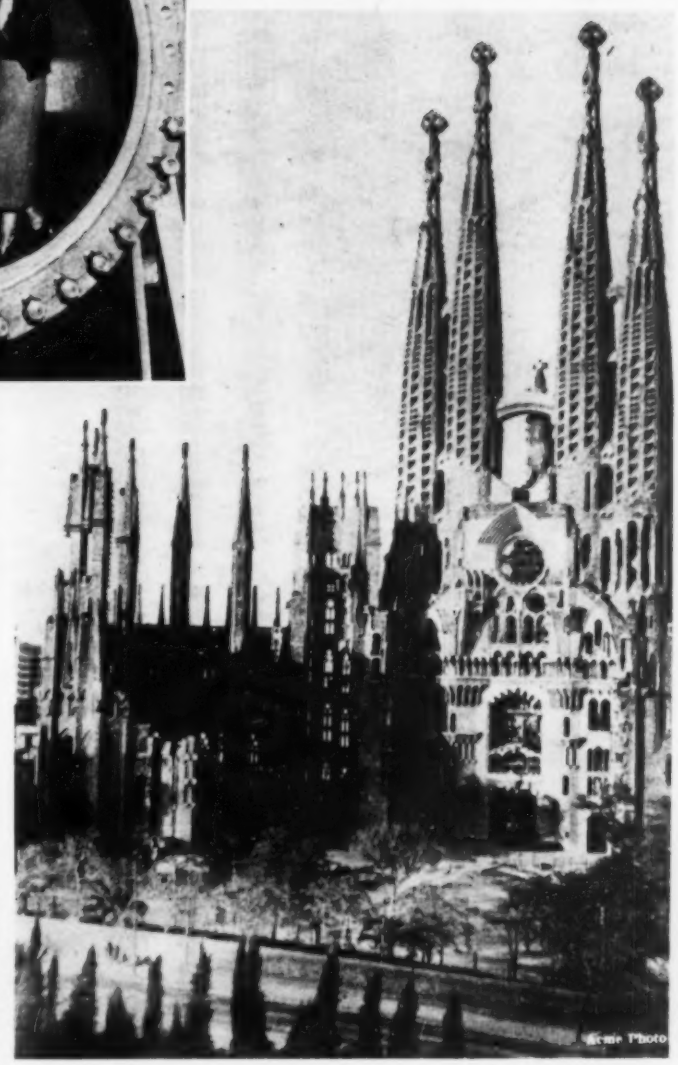


THE "CHAMP" inspects Boulder Dam. Riding in skip suspended from cableway high above canyon, Max Baer, world's heavyweight boxing champion, views progress of battle by U. S. Bureau of Reclamation and Six Companies Inc., contractors, to tame Colorado River.

LARGEST TURBINES *(above)* ever built are being completed in Allis-Chalmers erecting shop for shipment to Boulder Dam. Each of four units will develop 150,000 hp. under hydraulic head of 592 ft. View shows pressure regulator side of 10-ft. diameter casing weighing 250 tons.



TIGHT FIT. Heavy section of 30-ft. diameter steel penstock pipe for Boulder dam project is lowered by cableway to car at tunnel adit.



ARCHITECTURAL NOVELTY *(right)* is offered by new church of the Sacred Family nearing completion in Barcelona, Spain, after years of construction. Treatment is expression of Catalan individuality.

Getting Down to

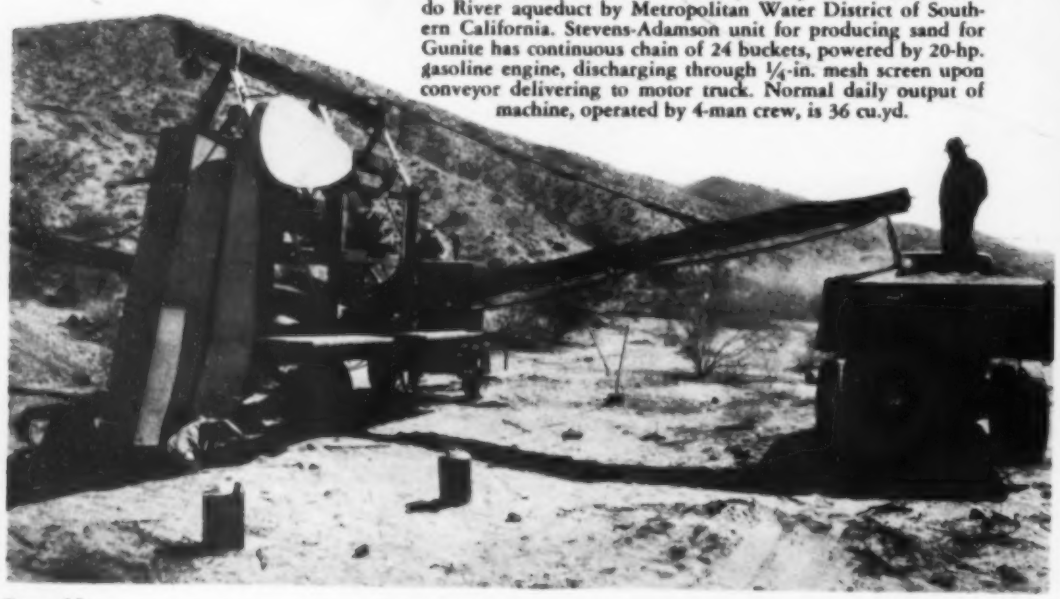
DETAILS

[Close-up Shots of Job Methods and Equipment]

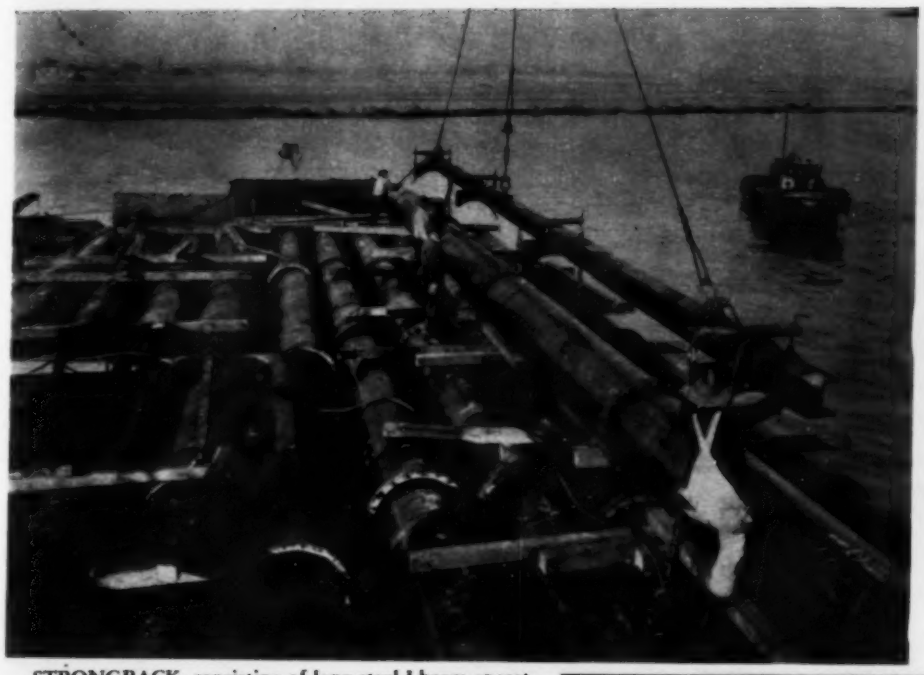
HEAVY SEGMENTAL CONCRETE BLOCKS for lining 21-ft. diameter (outside) shield-driven tunnel, completed several years ago to deliver water from River Rouge to plant of Ford Motor Co., at Dearborn, Mich., are placed by hydraulically operated erector arm. Each block measures 6x2½x1½ ft. Interlocking feature, designed by the late John F. O'Rourke, is provided by pair of recesses and corresponding projections, with surfaces in contact, when in place, to take thrust of shield when shoved by 20 hydraulic jacks. There are 10 blocks, each weighing 3,420 lb., in each tunnel ring. Erector arm grasps block through "fingers" inserted in depressions cast in concave surface of segment. Contractor for tunnel was S. A. Healy Co., of Chicago.

WORLD'S LARGEST DUMP TRUCK UNIT, *(left)*, with a capacity of 35 cu.yd. of muck weighing 61 tons, handles spoil at Bonneville dam, $39,000,000 power and navigation project on Columbia River in Washington. Mack truck hauls LeTourneau "buggy," which is loaded by Bucyrus-Monighan dragline delivering 6 tons of material at each "bite." This outfit rides upon a small fortune in rubber—26 pneumatic tires in all. This heavy haulage unit far surpasses in capacity the monster 16-cu.yd. Mack trucks with special bodies at Boulder and San Gabriel dams.

SAND-SCREENING MACHINE *(below)* is used on Colorado River aqueduct by Metropolitan Water District of Southern California. Stevens-Adamson unit for producing sand for Gunite has continuous chain of 24 buckets, powered by 20-hp. gasoline engine, discharging through ¼-in. mesh screen upon conveyor delivering to motor truck. Normal daily output of machine, operated by 4-man crew, is 36 cu.yd.



DUMPING DEVICE on 8-cu.yd. cableway bucket for handling concrete at Norris dam consists of hand-operated air valve which unlatches bottom gates. Workman at bucket is connecting valve with compressed air hose line. When empty, bucket gates close and latch automatically.



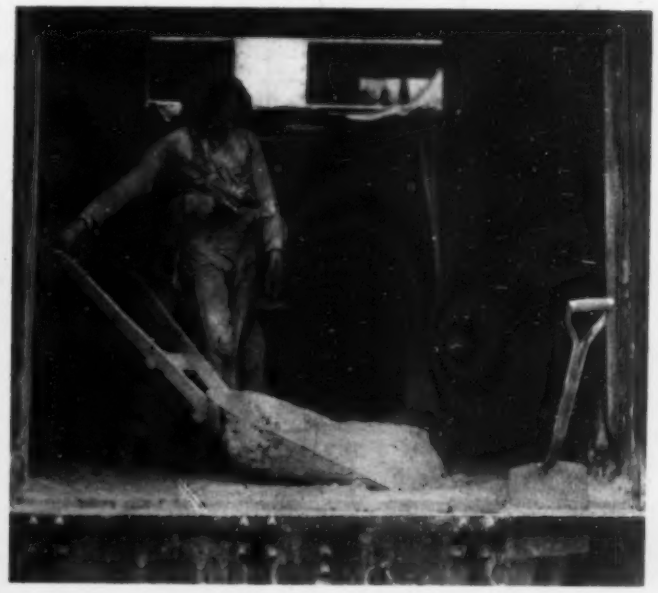
STRONGBACK, consisting of long steel I-beam operated by three-line sling from floating derrick, handles four-length bolted section of 30-in. cast-iron pipe forming corrosion-resistant outfall sewer line in San Pedro Bay, for Los Angeles, Calif.—Photo from American Cast-Iron Pipe Co.

STAKE PULLER used by Cooke Asphalt Paving Co., of Detroit, on asphalt resurfacing project west of Howell, Mich. Hook on chain suspended from lever arm grips stake and pulls it when arm is raised.

STEEL "MULE," drawn by hand, forms gutters on concrete pavement in Illinois.—Photo from C. M. Hathaway, engineer of construction, Illinois Division of Highways.

CAST IRON PAVEMENT is installed on 30-ft. test section in Wilmington, Del., by state highway and city street departments in cooperation with Lobdell Car Wheel Co. Hexagonal blocks, 10 in. wide, 20 in. long and 9/16 in. thick with 2-in. square surface bosses, eliminate straight-line joints. Undersurface of each 32-lb. block is reinforced by rib, making effective depth of block 1½ in. Cushion is loose sand-cement mix and joint filler is hot asphalt.

SELF-UNLOADING CARRIER deposits small stone fill in pockets of 50x50-ft. timber crib, 28 ft. deep, forming base of new lighthouse along shore of Lake Erie at Conneaut, Ohio. Crib was floated to place and sunk by weight of 5-ton concrete blocks. Contractor, Great Lakes Dredge & Dock Co.



WHEELBARROW TRAY, mounted upon wheeled hand-truck, serves as scoop for unloading bulk cement from railway boxcars serving central mixing plant for Walsh Construction Co's. grade crossing elimination project for New York Central Railroad at Syracuse, N. Y.

GET THESE
LOW FUEL COST
LOWER ORIGINAL COST
LOWER MA

facts*

ABOUT ECONOMICAL TRACTOR OPERATION

WHEN it comes to tractor *costs*, there is just one figure to consider—one figure that means the difference between profit and loss—FINAL COST. Low fuel costs are fine . . . but sad is the story when repair costs are forgotten . . . or when no allowance is made for condition of the tractor when the job is done.

A-C Oil tractors do the work at Lowest Final Cost because they do not stop with low fuel costs. They burn low cost fuel and little of it. Their first cost is lower because horsepower and weight are properly balanced through improved design. Maintenance is lower because internal pressures are less than one-third those of the compression type. Depreciation is less because A-C Oil Tractors can "take it" . . . as demonstrated on tough jobs throughout the country.

When it comes to *performance* . . . A-C Oil Tractors consistently make more trips . . . do more work . . . at lower cost . . . than any other tractors built. Users who want FACTS are demonstrating this every day by actually comparing costs before they buy.

MODEL "L-O" . . . 76 DRAWBAR HORSEPOWER
MODEL "K-O" . . . 48 DRAWBAR HORSEPOWER

MAINTENANCE LESS DEPRECIATION LOWEST FINAL COST

After getting the *facts** McCormick Lumber Co. bought five Model "L-O" Tractors. This "L-O" at Camp Union, Washington, is doing the work at LOWEST FINAL COST.

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Old Brick Pavement Reclaimed With

NEW BRICK SURFACING

Paper (Slightly Condensed) Presented at Annual Meeting of National Paving Brick Association

By MORGAN P. O'BRIEN

City Engineer, Springfield, Ill.

THIS ARTICLE deals with the possibilities of reclaiming worn or otherwise rough brick city pavements. Old pavements other than brick are equally valuable as foundations for new brick surfaces, and the methods outlined are applicable with such variations as conditions require. There is no wisdom or economy in destroying the real value that exists in a pavement that has given service for twenty-five years or more, when

BEFORE AND AFTER. Upper view shows condition of Seventh Street in Springfield, Ill., originally paved with brick in 1893. Lower view illustrates condition of street repaved with brick in 1932, utilizing old pavement as a base for new brick surface.

that value can easily be retained if the old pavement is properly prepared for use as a base for a new surface.

Curbs—After many years of discussion and explanation of resurfacing, I find two stock questions raised: The first is, "What about curbs? How are you going to build up your old pavement 3½ in. or more and have any curb showing?" The answer is that if you have a 6-in. curb to start with, and raise the surface of the pavement at the curb line 4 in., you have only 2 in. left, and what about it? Today storm water is seldom carried more than about 300 ft. before it encounters a street inlet, and if a rainfall sufficiently heavy to cause flooding occurs, it will cause little, if any, damage. I have observed many resurfaced streets, where less than 1 in. of curb remained in sight, and there was not even the slightest evidence of damage caused by flooding. If, however, the grade of the street is such that a high curb is needed, it is a very simple and economical matter to increase the gutter capacity of the new surface, in the case of brick, by removing and relaying the old brick flatwise in the existing gutter, and still further to increase gutter area by decreasing the thickness of the cushion and, if necessary, by using bevelled brick at the curb line. It will seldom be necessary to use these methods and fears regarding a small amount of curb protruding above the new surface are largely imaginary. Of course, where old pavements are being widened—and nearly always they are too narrow besides being rough—any height of curb that the designer feels necessary may be installed.

Intersections—The second question is, "How about intersections? How can you build up a street and not have a bump at the intersecting paved street?" The answer to this is that every inter-

section, in fact, every wing of every intersection, offers a separate problem, and in my opinion, the solution is the measure of the ability of the designer to meet problems as he finds them. For instance, it is sometimes necessary to remove the existing pavement surface over the entire area of the intersection and to build up the existing base to the proper contour and grade, which, with the wearing surface, will fit into the grade and section of the incoming pavement. It is seldom necessary to do this, however, and often the adjustment can be made by removing the existing surface on only a part of the wing, and, by the proper use of a build-up course, obtain a perfectly

BRICK ARE LAID upon a mastic bedding course, an improvement upon plain sand or sand-cement cushions employed in former years.

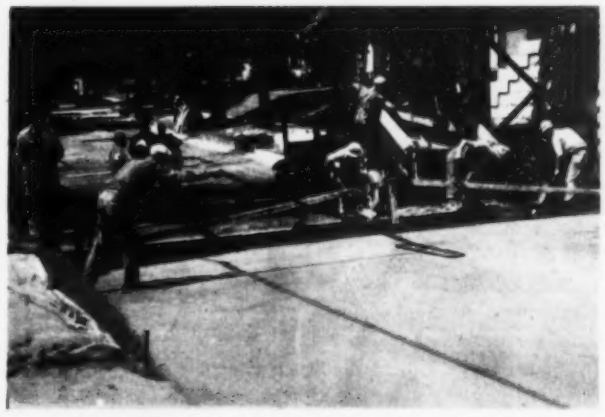
replacement with gravel or stone will give the desired result. In more serious cases a short line of drain tile may be necessary. When base failure has occurred, the destroyed material should be removed and replaced. The greatest factor contributing to roughness has been the shifting of the sand cushion due to the entrance of moisture. This is easily understood when it is recalled to mind that a sand filler was used in the early brick pavements, followed later by the use of a cement grout, and its consequent cracking, causing breaks in the bond between the bricks.

When the survey has been completed the engineer determines the cross-section he desires to install, and grades at

LEVELING COURSE of concrete and mortar is applied to correct inequalities in old paved surface before new paving is laid upon it as base.

sulting in consequent settlement; and, occasionally, a naturally weak area of subgrade caused by excessive moisture confined in such a way that it will not drain. It may be found, also, that when a concrete foundation exists, excessive cracking has occurred, causing a displacement of surface.

Leveling Course—The roughness occasioned by worn brick, or a settlement of the wearing course due to shifting of cushion is easily cured by application of a leveling course of mortar, concrete or bituminous material. This material is best paid for by the cubic yard, or by the ton when bituminous materials are used, and measurements at the mixing



WITH TRUSSED TEMPLATE concrete for leveling course is spread and brought accurately to grade for new pavement base.

smooth riding connection. Again, the pavement in the adjoining street may be removed and rebuilt to procure the proper connection. There is no intersection problem that cannot be solved by an intelligent study of the conditions.

Causes of Roughness—The usual causes of roughness in old brick pavement are: Edges of brick worn to a rounded shape by horseshoe calks and steel tires in years gone by; shifting of sand cushion, causing settling or raising of brick, due to moisture penetrating the wearing surface and causing a sort of semi-fluid condition in the sand; service trenches of various kinds which have been improperly backfilled, re-

MASTIC BEDDING COURSE is applied and spread to uniform thickness on accurately leveled base course.

curb lines are corrected for any deficiencies existing in surface drainage facilities. New inlet castings may be needed, and curbs will no doubt need certain repairs or replacements. Renewal of sewer or utility manholes, and, of course, their adjustment to the new grade will have to be provided for.

The grade, longitudinal and transverse, having been determined, the quantity of leveling material, or build-up, is next determined. Where a small area of old brick is too high to fit the new surface the wearing surface and cushion in such area is removed and the surface brought to grade by the application of concrete, usually, to the old foundation course. The leveling course

SMOOTHNESS OF FINISHED PAVEMENT depends upon uniformity of thickness of mastic cushion course.

plant are the best way to determine the amount used. Where improperly filled trenches have settled, carrying both base and wearing course into depressions, the pavements should be opened so that a thorough examination of the trench may be made. It will often be found necessary to add a fill to the old trench, thoroughly tamped in thin layers. When the trench has been brought to the level of the subgrade a concrete slab, reinforced if necessary, should be installed, of a thickness reaching from subgrade to the surface of the old pavement. When subgrade weaknesses appear to have caused trouble it may be that removal of a portion of the earth and its

MORTAR COURSE is applied to level uneven surface of old brick pavement serving as a base.

NEWLY LAID BRICK SURFACE is accurately tested for smoothness with 10-ft. straight-edge before asphaltic filler is poured into joints.

is then applied to the old surface and, by templates and very careful use of the straight-edge, brought to the desired grade.

Guide for Templates—In this connection an ingenious and simple system of guides for the templates was worked out during the past construction season. Instead of using steel or wooden forms on which to slide the templates, strips of concrete or mortar are laid to exact grade at curb lines and center. The true grades at curb lines are marked on face of curb at 25-ft. intervals and connected by chalk lines: On centers and quarters, when necessary, grade points at the same intervals are established by the engineers. These points are then connected, longitudinally, by strips of mortar or concrete, at least one day in advance of spreading mortar, and provide a true, uniform support for the templates. At intersections the same methods are used, including such diagonal grades as are necessary to secure the desired surface.

Bedding Course — I cannot too strongly emphasize the absolute necessity of a true surface of a base course under brick, or any other wearing material. This is not peculiar to resurfacing projects, but applies equally to an entirely new job. The cushion, or bedding course, must be of uniform thickness, preferably not more than ¾ in. This uniformity is even more important where the rather recently developed mastic is used, so that any settlement, however slight, under traffic will be such as to keep the wearing surface in a true plane. The mastic bedding course is, of course, preferable to dry sand for the insurance it affords against shifting should moisture enter the structure. Thorough rolling and luting is again required, and the surface should be tested with the 10-ft straight-edge.

In improvement made in the manufacture of paving brick during the past two years the industry has made greater progress than in any comparable period. The uniformity in size and toughness, together with the rather general use of side and end lugs, have made possible the neat, well-filled surfaces and straight joints that add so much to the appearance of a brick street. There can be no doubt that the close uniformity of wear now obtainable will add years to the life of such pavement.

Laying Brick — By paying close attention to the manner of setting brick, and by proper use of the roller, there will be little difficulty in obtaining a surface that will not vary more than ⅛ in. in 10 ft., and this should in all cases be the maximum tolerance. Should high spots or depressions appear after rolling, the brick in these areas must be removed, the cushion carefully adjusted, and the brick replaced so that after application of the roller the surface will be at grade.

Since the introduction of the side and end lugs, the problem of thorough filling of joints has become much easier of solution. The increased joint space has permitted the use of a spray or paint coat on the surface, affording an easy way to remove excess filling material. During the last year a mixture consisting of 1½ lb. starch, 34½ lb. of calcium chloride and 64 lb. of water, applied in a spray, has given satisfactory results. During extremely hot days, when the filling material remains "gummy" for a considerable time, it is found that water applied to the surface of the excess asphalt filler by means of a garden hose, permits removal immediately adjacent to the area in which filling is proceeding. There can be little objection to the slightly increased cost of removal of excess filler, which has run from 3 to 5 c. per square yard. The improvement in appearance alone would justify this small cost, but the fact that there is no filler to be picked up and then dropped by vehicles, producing a rough pavement, which condition will often continue for several years, is a more important reason for removal.

WATER flushed over surface of excess joint filler facilitates removal of asphalt by hand scrapers.

GUTTER TREATMENT, showing application of "wedge" brick along edge of flag.

CALCIUM CHLORIDE SPRAY is applied to brick to facilitate peeling off of excess joint filler.

SCRAPING OFF excess joint filler from brick surface sprayed with calcium chloride to aid "peeling" process.

PIPE WELDING *for Plant Construction*

By G. E. DEATHERAGE *and* J. B. LATTERNER

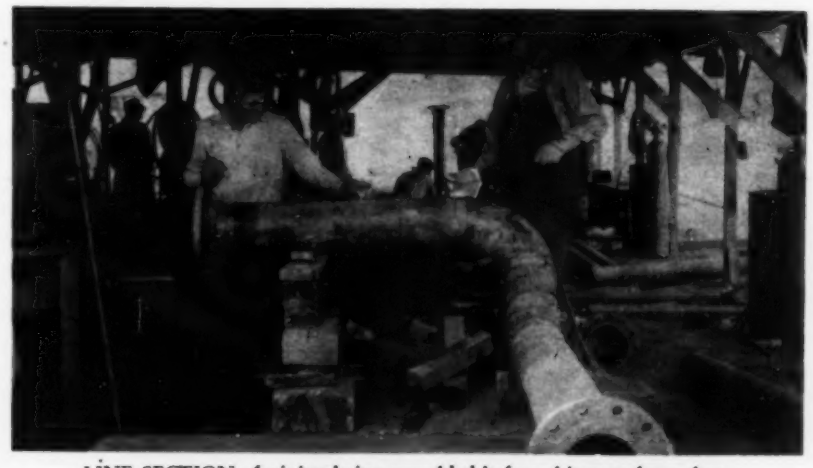
General Superintendent of Construction — *Chief, Construction Planning Dept.,*

Carbide & Chemicals Corp.

(Abstract of Paper Before International Acetylene Association)

FABRICATING, by oxy-acetylene welding, four-piece aluminum elbows for aluminum piping system.

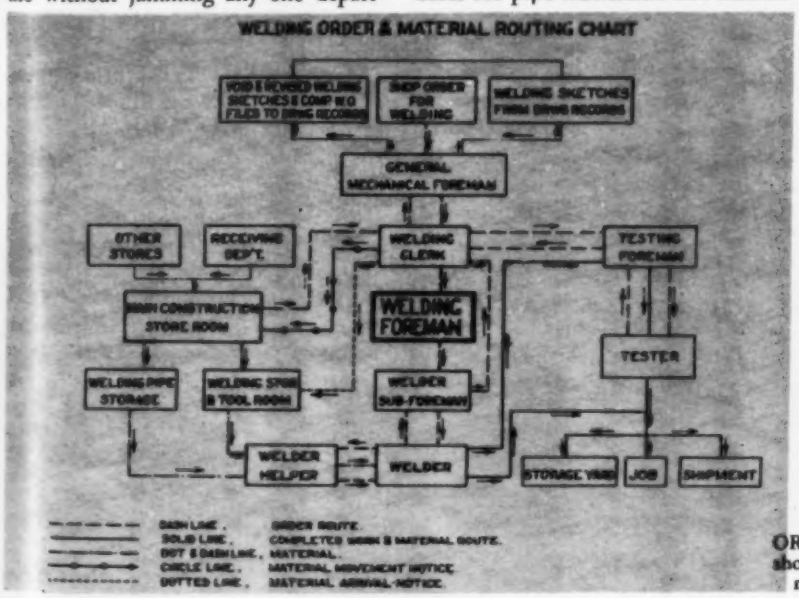
IN INDUSTRIAL PLANTS where fluids and gases are processed at high temperatures and pressures, the piping must be designed and constructed with the same care as the pressure vessels which the piping connects. Thus, when piping is fabricated right on the job during construction of a plant, it becomes one of the most important jobs the field forces have to do. If it should be a chemical plant containing a maze of piping, interconnecting practically every piece of equipment in the place, fabrication and erection of the piping becomes by far the most important field operation, worth the unceasing attention of the construction superintendent.



LINE SECTION of piping being oxwelded before shipment from shop to job for installation in chemical plant building.

On a well organized construction job the erection of lines is pushed aggressively because of other work waiting on the piping. A delay in the installation of some one line might interfere with the completion of a half dozen related jobs, and this could not be tolerated. The organization must be such that pipe materials are received, fabricated, and the piping erected in accordance with a general construction schedule without jamming any one department with more material or work than can be handled, and without having an overmanned labor crew.

In the construction of various units of a large chemical plant in West Virginia we early recognized the important part that the piping organization played in the rapid and economical completion of the job. Over a period of years detailed and efficient procedures for pipe fabrication and installation have evolved from our interest in this phase of the work and our constant desire to improve on past practice. In so far as possible it has been our aim to bring together into a single systematic organization the many miscellaneous activities found on a construction job—to put field work on the same basis common to most all shop production layouts.



ORGANIZATION CHART *(left)*, showing domain of welding foreman and routing of materials.

In our piping work all joints that possibly can be oxwelded are oxwelded. Hence, the piping organization is built entirely around the oxy-acetylene process to take the fullest advantage of this versatile method of joining pipe. Welding was adopted originally for piping and pressure vessels for reasons of safety and freedom from maintenance. Cost was a factor little considered. Today, if it should be found necessary to do without welding, we are confident that the cost of piping in place would be greatly increased, and what is even more serious, the overall time for completing a job would be greater. This is because welding has made practicable "made-to-measure" fabrication and erection of a complete piping job. In the eyes of the construction superintendent this is probably the most important single contribution of welding to construction practices because it greatly simplifies the task of putting field work on a systematic basis. It puts piping installation in the same class with structural steel erection, where members are fabricated to exact dimensions in the shop and are fitted together orderly in the field, in complete coordination with other portions of the construction program.

Plan of Operation—The plan of operation built around the "made-to-measure" idea is the logical outcome of experience gained on a number of jobs and the recognition of certain basic facts. Foremost among these is the facility with which a section of a line can be fabricated to exact dimensions by welding—no matter what size the pipe—with assurance that the section will fit into its proper place in the line when delivered on the job. This has been possible in the past with flanged piping, but for the smaller diameter or lower pressure screw coupled lines prefabrication could not be practiced. With welding the entire job is carried out on a production basis using a single method in shop and field in the place of several.

A second factor recognized in applying production methods to piping installation was that the activities of the workman should be confined solely to actual fabrication and erection, leaving the planning to engineers trained in this work. The numerous duties of any one individual under the old state of affairs are reduced to the several for which he is best fitted, with a gratifying decrease in the overall labor cost.

As the third important step in conducting the job on a production basis, procedure in shop and field is designed to relieve the welder of all duties except that of welding. In this way he may concentrate fully on his work in the interest of weld quality and good production. Since the welds are as im-

portant to the completed job as the pipe or welding fittings, it is only to be expected that every care should be taken in making them, yet that their production be facilitated in every way possible. Since the operator is free to do nothing but weld, the amount of production to be expected each day can be gaged fairly accurately. Thus the length of time needed to complete a certain line, with one or more operators at work on it, can be estimated closely and the schedule for the entire job balanced accordingly.

The fourth move, eliminating a constant source of confusion on the job, was considering each line from terminal to terminal as a distinct unit, just as though it were a tank or other piece of equipment. Each line is given a definite designation, and all shop drawings, bills of material and work orders refer to this line number. The line is fabricated in easily handled sections in the welding shop and is assembled on the job as a unit, without any stopping until completed.

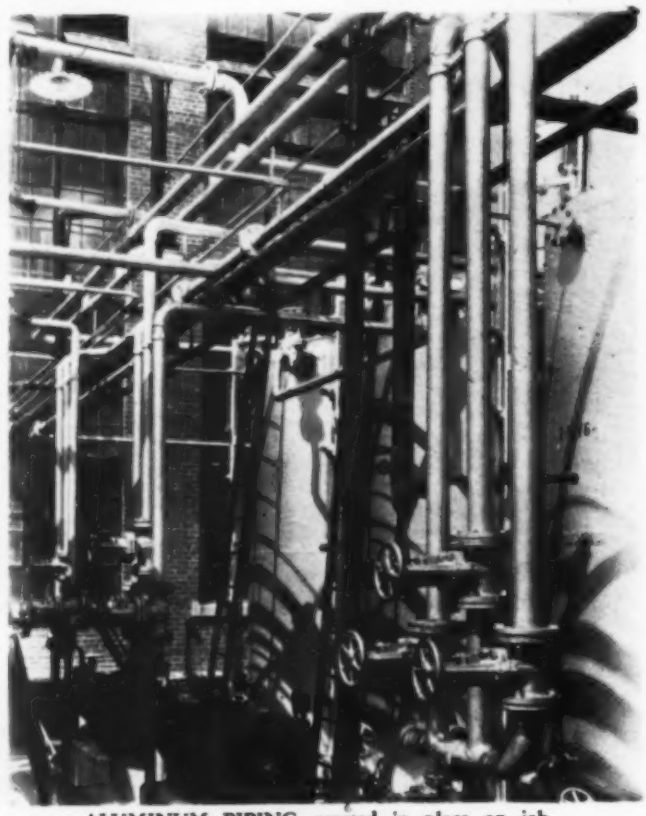
The fifth factor is placing responsibility for the welding. This is given to one man, the welding foreman, who has under him a number of sub-foremen who actually direct and supervise the welding. The welding foreman is in direct charge of the welding shop where all piping is fabricated before being sent to the job for erection. He is also responsible for welding done on the job, whether for erection, alteration or repair, and he lends operators together with their welding equipment to other foremen for this purpose. Actual erection is in charge of pipe fitting foremen, both they and the welding foreman coming under a general mechanical foreman.

The last factor has to do with the amount of welding done in shop and field. It was soon recognized that shop welds, being made under more ideal conditions, could be made with less supervision and at lower expense than welds in the field. Consequently a line is broken up into as few units as possible for fabrication, based on the size and weight of sections that can be readily handled, thereby keeping the number of field welds to a minimum.

Six Basic Factors—It is around these six factors then that the plan of operation is laid out: (1) shop fabrication of all lines in good-sized sections, with assurance of ready assembly in the field; (2) giving each individual in the organization a minimum number of duties, to the end that efficiency is increased; (3) giving the key workman in the organization, the welder, nothing to do but welding so that quality and production will be uniformly high; (4) considering the entire piping job as divided into a number of unit lines, each a separate item of equipment; (5) placing the responsibility for all welding, because of its importance, under a welding foreman; and (6) performing the greater part of the welding in the shop where it can be done economically and speedily.

With the welding department uppermost in mind, let us see how the plan operates. First to be considered is the origin of requests for the welding crew to do work. These come from a number of sources. Generally the requests are in the form of standard pipe sketches or shop drawings forwarded to the welding shop from the general mechanical foreman as authority to begin work for new construction. However, they may also be shop orders for doing work not contemplated in the original design, and requests from other departments such as the erection department for operators to do tie-in welding in the field.

Job Orders and Files—No work is done except by authority of some such job order—pipe sketch or shop order—from the general mechanical foreman. It is important to bear in mind that each job order is considered a unit of work—a definite job usually requiring the services of a single welder and his helper. The job may call for the fabrication of a header, or the tack-welding and welding of nine joints required in erecting a line in the field. Each such job is of course chargeable to a given line, and therefore no job order concerns more than one line.



ALUMINUM PIPING erected in place on job. Most of welding was done in shop.

Job orders as received are recorded in a Works File and a Works Calendar File by the welding clerk who is an assistant under the welding foreman. The Works File is simply a blank form in which all needed information about a particular unit of work, the job order, is recorded as the job progresses. The status of any job order at any particular time is thus made available. Provision is made on the form for the number of the line for which the work is being done, the date wanted, the number of the bill of material which was authority for material to be purchased for this particular portion of the job, when the material was received, when the job was started and completed, the number of the welder and his foreman, the welding time, results of the tests and disposition of the work upon completion—whether it was placed in storage temporarily or sent direct to the job.

The date wanted is important and will usually be determined by the date the material is scheduled to arrive on the job, this date being supplied by the Bill of Material which is available to the welding clerk along with the job order. If the work happens to be field welding and is not covered by a Bill of Material, the date wanted is secured from the field job order.

The job order is then assigned a date in the Works Calendar File in either of two ways. If the material needed for it has been received or if no material is required, the job is assigned to the "active" Works Calendar File under the date it is wanted. If the material required is still to come, the job order is listed in the Pending Works Calendar File. In this way the work is mapped out a week or more in advance. Should material not arrive in time it can be checked up before the work is actually to start, and if the work scheduled for a certain date is more than the existing organization can take care of, additional workmen are obtained or some of the work is advanced to a later date.

Material Supply—The next step is to get moving to the welding shop the material that will be needed there on the following day for the shop jobs scheduled on the calendar. This is attended to by the welding clerk who forwards to the main receiving warehouse the Bills of Material covering the work which is to be done. In this way overcrowding is eliminated in the storeroom at the welding shop because the material is received just a short time before it is due for fabrication.

At the time the welding clerk orders material such as welding fittings moved from the main warehouse, he sends a copy of the Bill of Material to the welding shop storeroom so that provision can be made to handle the material when it arrives. Material from the main warehouse is delivered to the welding shop storeroom in open-top boxes, each box tagged with the work order number and the Bill of Material number. The boxes are arranged in the order of the Bill of Material number so that when needed each can be readily located.

At the beginning of a day's work, the welding foreman takes the various jobs scheduled to start on the particular day and assigns them to his various sub-foremen, taking into consideration work not completed the previous day. As explained previously, the authority for a particular job is either a shop drawing or an order to do welding in the field, the one a blue print and the other a form with the reverse side blank. Before these are given to the sub-foremen they are rubber stamped on the back with a special form.

Routing the Job—Information about the routing of the job is recorded in this form from the time it is assigned until the testing is completed and it is sent to the storage yard or to the job. This rubber-stamped form also calls for the name of the sub-foreman, the number of the welder and the workman who applies the test, the date given to the welding foreman, the welding time, testing time and final disposition of the work. For welding jobs not in the shop area, space is provided on the form for the name of the field foreman the welder is to report to and the time he was away from the shop.

The job order with the form stamped on the back is passed from workman to workman as the job passes through the shop and the stage of the work at any particular time can be readily learned.

The welding sub-foremen assign the jobs to various welders under them in sufficient time for the welders' helpers to get the pipe and welding fittings necessary from the storage area, eliminating any break in the flow of work. When a job order is presented at the welding shop storeroom for the welding fittings and flanges required, a list of the pipe called for on the order is immediately forwarded to the pipe yard so that the exact lengths needed can be made ready. The welder's helper is giv-

COPPER PIPING being fabricated by bronze welding. Van Stone lap permits use of steel flanges.

en a duplicate copy of the order to the pipe yard so that he can pick up the pipe as needed.

A record is kept of welding time and all welds are stamped with the welder's assigned number to fix responsibility for the welding and time consumed. Each section of a line fabricated in the shop is also marked with the correct order number, number of the line and a number identifying the particular section.

The work is tested in accordance with its service requirements, after which it is held temporarily in a storage area or delivered to the job, depending on how soon the particular line is to be erected.

Jobs Outside Shop—For welding jobs outside the shop area the welder assigned to the work takes the order and gets his equipment and welding supplies to the job with the cooperation of the welding clerk who arranges in advance for the necessary transportation. The welder does the work specified, stamps the welds with his number, and returns to the shop. If the subforeman believes it necessary, he accompanies the welder to the job to see that the work gets under way and is performed in a satisfactory manner.

The field foreman to whom the welder reports for work records the time of the welder's arrival and departure on the back of the job order and gives the welder any instructions he may need in the performance of the work. He also notes whether the work was satisfactory and complete, and gives the job order to the welder to be returned to his sub-foreman.

The job order is finally returned to the welding clerk with complete information in the form stamped on the back. He transfers as much of the information on the back of the job order to the work file as necessary, and passes the job order along to the general mechanical foreman which is notification to him that the work has been completed.

These records required on welding work in the shop and field are relatively simple to keep and definitely fix responsibility for each step of the work. No orders or requests are given verbally in following this procedure and in the memorandum system followed all work of whatever type performed, whether trucking, testing or welding, is chargeable to some job. In this way cost accounting is also greatly simplified.

Welding Equipment and Supplies—The care used in routing pipe and welding fittings on the job to eliminate holdups on account of material shortage has already been mentioned. Similar care is exercised in the handling of welding equipment and supplies. To each welder is issued a set of tool checks, one of which he gives up to the toolroom clerk for a kit of tools, another for a welding outfit and the others for any special equipment he may need.

Welding supplies such as rods, flux, etc., are charged to the proper line number. It is relatively easy to estimate the amount required for the job since the number and size of the welds can be taken from the job orders. Each job order of course refers to a particular line. To make sure that there is never a shortage of welding supplies, material is reordered just as soon as the inventory gets down to a minimum figure determined upon.

Reports—Various daily and weekly reports are required of the welding foreman and his men in order that the construction superintendent may know about the progress and quality of the welding. One of these is a daily report on the welders covering the estimated welding time for the previous day compared to actual welding time. Another is a weekly report on welders covering estimated welding time compared to actual welding time and in addition the number of hours worked to date on pipe welding per leak for each welder.

A weekly report on the amount of work going through the welding shop calls for an estimate of the number of hours of uncompleted work held over from the previous week, estimated hours of work scheduled for the current week, the probable actual number of working hours and the balance which will have to be carried over to the next week. In addition the hours scheduled for the next week are reported from which the number of welders required can be estimated. A welding service record is maintained for each welder so that if he should leave the company but be considered for reemployment at a future date, his past record would give specific indication of his ability.

In building up a smoothly running organization we have had one paramount thought in mind: That the American factory industrial system of specialization and planning has produced really astounding results in the manufacture of quality products at low cost, and that the same idea can be applied in large degree to field construction practice.

Field construction activities in the past were left almost altogether in the hands of the foreman. He personally supervised listing, material needed, securing it from the storehouse, fabricating it and putting it in place. The construction foreman for years was the king-pin about which all activities revolved. This was the condition requiring change.

In discussing organization, we do not pretend to present anything new as far as fundamentals are concerned, but only the application of fundamentals we have made to piping construction wherein welding was the major tool employed.

DENOTE RECEIVED BY CHECK MARK AND PASS ON TO

FOREMAN ☐ — TESTING FOREMAN ☐
SUBFOREMAN ☐ — TESTER ☐
WELDER ☐ — TESTING FOREMAN ☐
CHECKER ☐ — WELDING CLERK ☐
WELDING CLERK ☐

WELDING TIME — TESTING TIME

START — START
COMPLETED_____ — COMPLETED_____
TOTAL — TOTAL

DISPOSITION OF COMPLETED WORK FROM

WELDER TO — TESTER TO

TESTING FOREMAN ☐ — STORAGE YARD ☐
STORAGE YARD — JOB
JOB ☐ — SHIPMENT ☐

WELDER No.

SUB-FOREMAN

TESTER No.

No. OF LEAKS

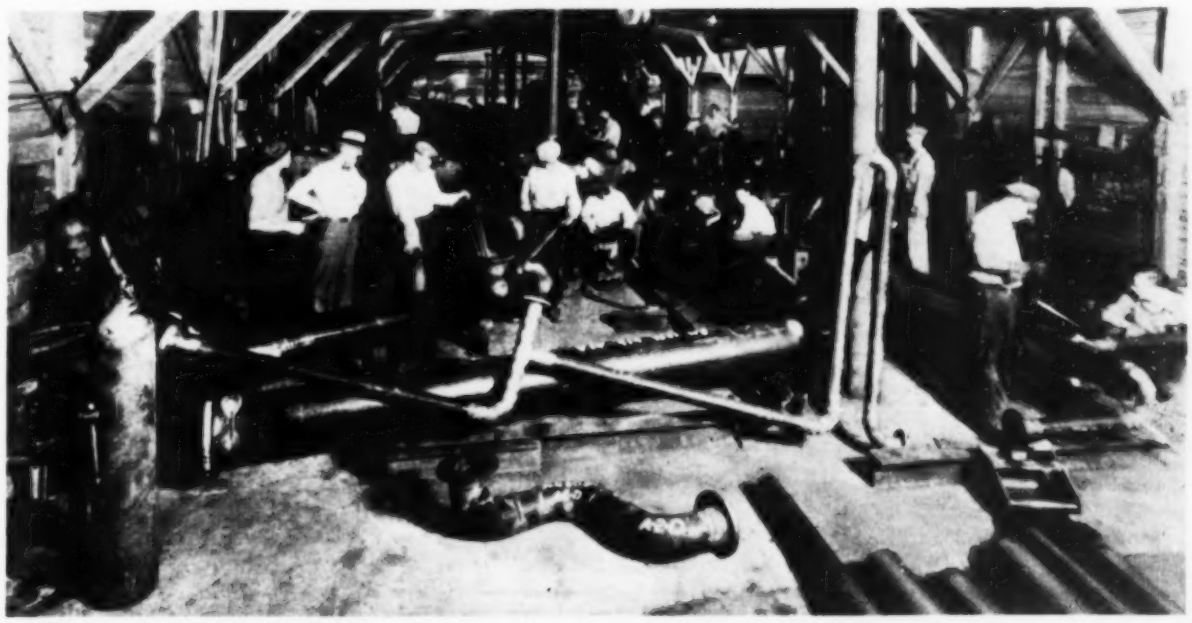
TO WELDING FOREMAN
DATE

FOR JOBS NOT IN SHOP AREA

REPORT TO
TIME ARRIVED
TIME LEFT
JOB COMP. AND O. K.

TIME LEFT SHOP
TIME RETURNED
TOTAL TIME

BLANK FORM stamped on back of pipe sketches and shop orders which follow job in field.



WELDING SHOP where lines of piping are fabricated in sections prior to erection in field.

PROGRESS CHART

Controls Building At Rockefeller Center

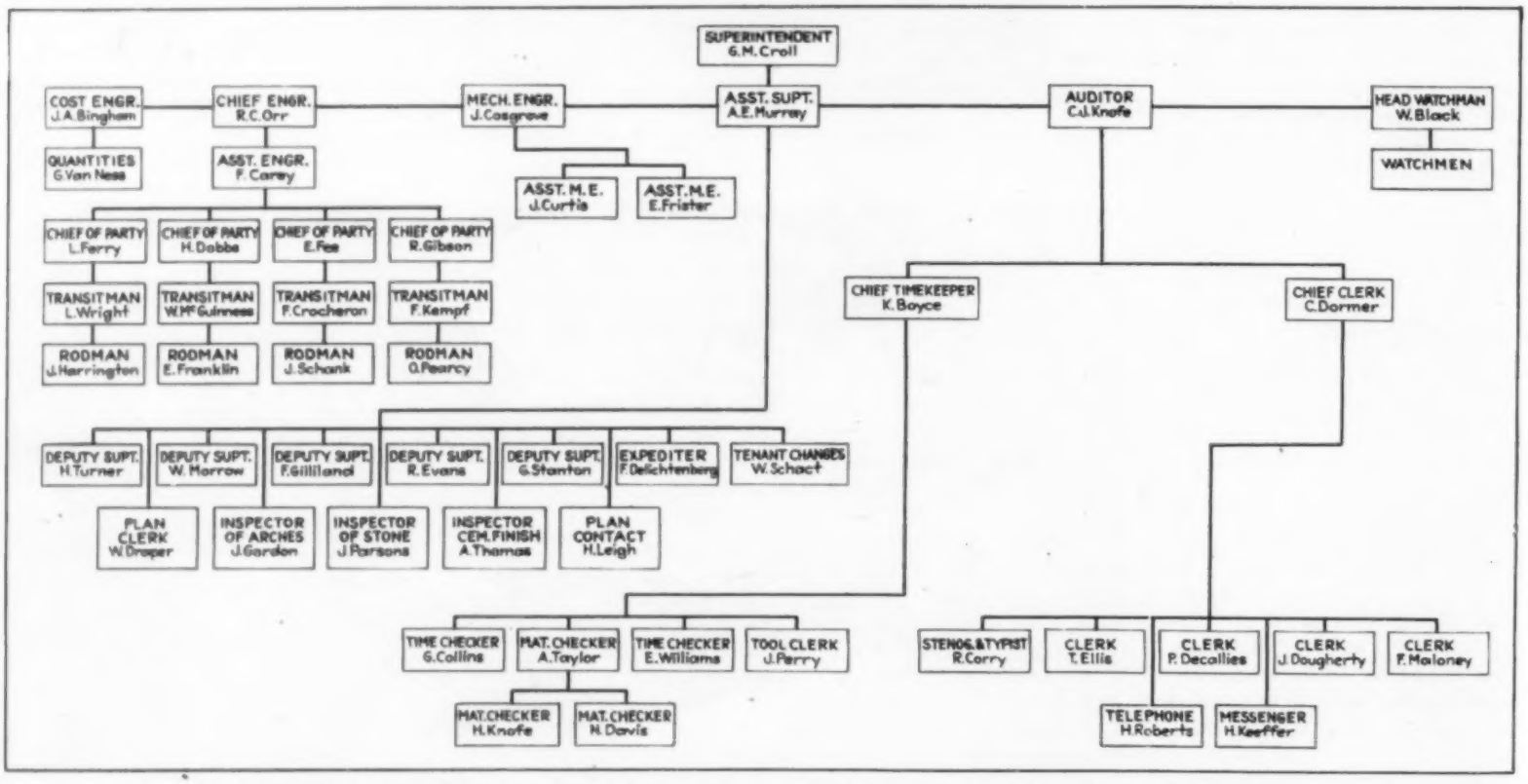
A SIMPLIFIED progress chart designed to facilitate both preliminary forecasting and active regulation of building operations serves John Lowry, Inc., of New York City, in executing its contract for Building 4A-4B-6, in Rockefeller Center, as described in *Construction Methods*, March, 1935, pp. 50-55. An earlier chart of the same general type was developed by the Lowry organization for its first contract in Rockefeller Center, calling for construction of a single unit embracing the 31-story RKO office building and the Radio City Music Hall, a theater seating 6,200 persons. For the present work, which consists essentially of a 38-story office building with two connected 6-story shopping wings facing Fifth Ave., the contractor made some improvements in the original chart and brought it up to the form reproduced with these notes. A ground floor plan and description of the building appeared in last month's article.

A large cross-section sheet provides the foundation for the progress chart, with horizontal spaces representing time and vertical spaces indicating floors of the building. Predicted progress for the various trades is shown by sloping parallel lines. So long as the lines do not intersect, no conflict of trades can occur. This distinction does not apply to the elevator trades, whose installations to various levels are indicated by vertical lines at the dates specified for completion. The slope of other lines is governed by the time allotted for construction. On this project, the contractor started work on Aug. 20, 1934, and set April 13, 1935, as the date for completion. To meet this schedule, each trade had to advance almost five floors a week when working in the tower office building above the 7th floor.

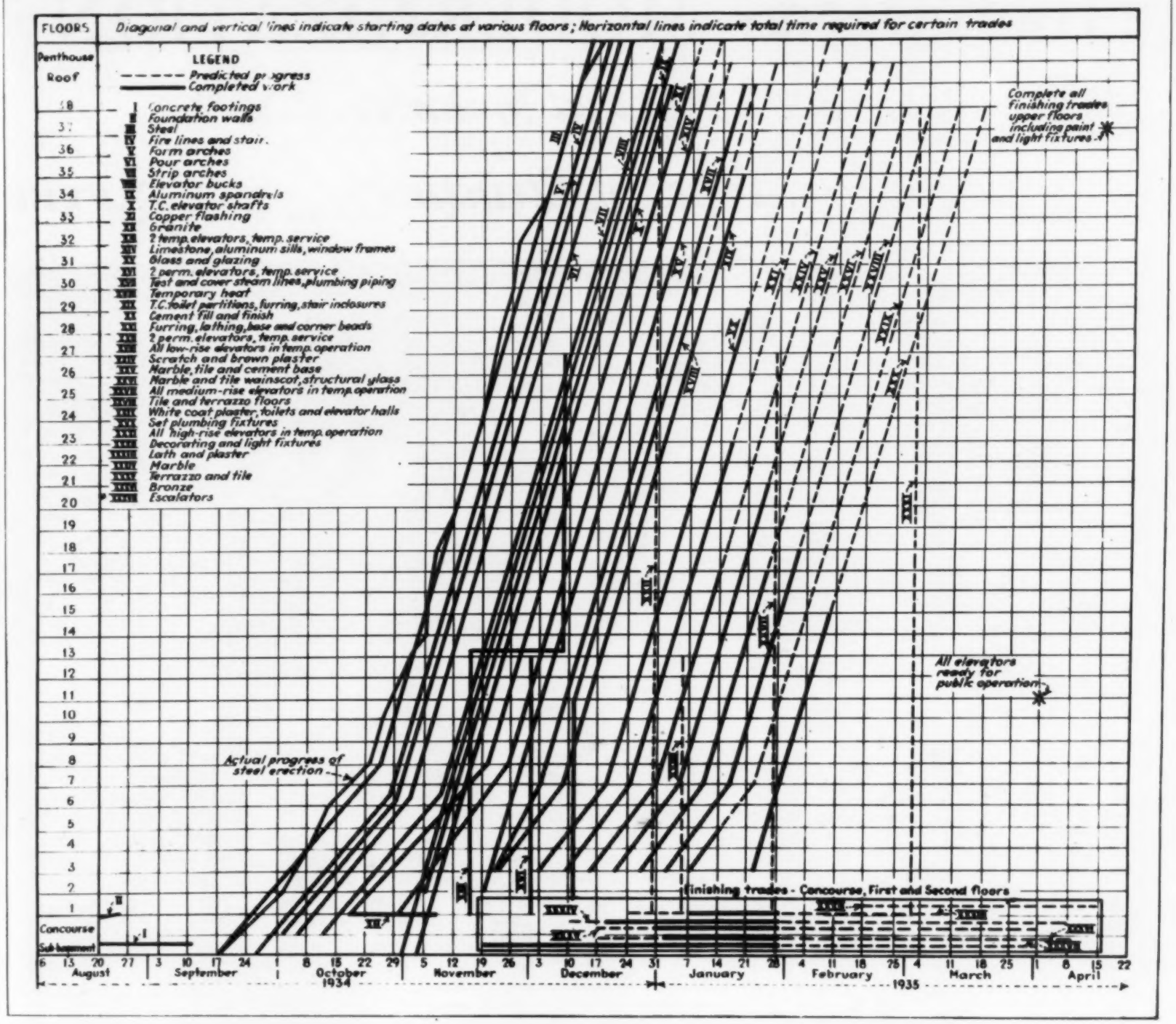
PRESENT CONTRACT of John Lowry, Inc., in Rockefeller Center involves 38-story steel-frame office building with two shopping wings facing Fifth Ave. At far end of same block are 31-story office building and huge theatre built under earlier contract.

At the end of each week, the completed work accomplished by each trade is indicated by filling in the broken line of predicted progress to the proper floor level. It will be noted that this solid line lies on the broken line; *the chart is not used to plot the actual progress curves of the various trades.* To show how the record of actual progress varies from a straight line, the true progress of steel erection has been plotted on the accompanying chart.

As can be seen by a glance at the chart, the solid lines indicate clearly the positions of the various trades at a given date. Assuming that the chart as drawn has been brought up to date on Jan. 14, it immediately is apparent that the outside trades XI, XIV and XV (representing, respectively, copper flashing; limestone, aluminum sills, window frames; and glass and glazing)



ORGANIZATION DIAGRAM of contractor's field staff indicates division of responsibilities under various subordinates who report to one coordinating head.


FLOORS
Diagonal and vertical lines indicate starting dates at various floors; Horizontal lines indicate total time required for certain trades
LEGEND
Predicted progress
Completed work
I Concrete footings
II Foundation walls
III Steel
IV Fire lines and stairs
V Form arches
VI Pour arches
VII Strip arches
VIII Elevator bucks
IX Aluminum spandrels
X T.C. elevator shafts
XI Copper flashing
XII Granite
XIII 2 temp. elevators, temp. service
XIV Limestone, aluminum sills, window frames
XV Glass and glazing
XVI 2 perm. elevators, temp. service
XVII Test and cover steam lines, plumbing piping
XVIII Temporary heat
XIX T.C. toilet partitions, furring, stair inclosures
XX Cement fill and finish
XXI Furring, lathing, base and corner beads
XXII 2 perm. elevators, temp. service
XXIII All low-rise elevators in temp. operation
XXIV Scratch and brown plaster
XXV Marble, tile and cement base
XXVI Marble and tile wainscot, structural glass
XXVII All medium-rise elevators in temp. operation
XXVIII Tile and terrazzo floors
XXIX White coat plaster, toilets and elevator halls
XXX Set plumbing fixtures
XXXI All high-rise elevators in temp. operation
XXXII Decorating and light fixtures
XXXIII Lath and plaster
XXXIV Marble
XXXV Terrazzo and tile
XXXVI Bronze
XXXVII Escalators
Penthouse Roof
38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Concourse
Sub-basement
Complete all finishing trades upper floors including paint and light fixtures
All elevators ready for public operation
Actual progress of steel erection
Finishing trades - Concourse, First and Second floors
6 13 20 27 August
3 10 17 24 September
1 8 15 22 29 October
5 12 19 26 November
3 10 17 24 31 December
1934
7 14 21 28 January
4 11 18 25 February
4 11 18 25 March
1 8 15 22 April
1935

PROGRESS CHART indicates predicted progress for various trades by sloping parallel broken lines. As work advances, chart is brought up to date by filling in these lines as solid bars. On this exhibit, actual progress of steel erection is plotted to compare actual with predicted (straight-line) progress. Finishing trades on concourse, first and second floors have to wait until these floors can be released from other construction uses for final operations.

have been delayed by severe winter weather from keeping up to schedule. It should be explained here that the Roman numerals used to designate the progress lines on the accompanying reproduction were adopted by the editor to avoid close lettering on the reduced size of the chart. On the contractor's drawing, the names of the trades are printed directly on the progress lines to simplify reading of the chart.

A further study of the chart reveals that on Jan. 14 several of the inside trades, particularly XX, XXV, XXVI, XXVII and XXX (representing, in that order, cement fill and finish; marble, tile and cement base; marble and tile wainscot, structural glass; tile and terrazzo floors; and setting plumbing fixtures) are some distance ahead of scheduled progress. These trades have not been affected by the cold and stormy weather. By drawing a red or yellow vertical line corresponding with the Jan. 14 date on his blueprint, the general superintendent quickly compares the actual position of each trade with its predicted position. Thus trade XV (glass and glazing) is three days and three floors behind schedule, while trade XXV (marble, tile and cement base) is ten days and eight floors ahead of schedule.

In conjunction with a daily report from each subcontractor and from each of the general contractor's foremen on the job, the chart affords a reliable basis for regulating the operations of the various trades to keep them in line with predicted progress. It assists the superintendent in gaging the adequacy of the working force employed by each subcontractor and gives him ready evidence upon which to base an order for additional workmen when required.

Construction Organization—As shown by the accompanying diagram, the Lowry field organization on Building 4A-4B-6 is drawn on military lines, with each member responsible to one superior. In the construction division, a group of six deputy superintendents, three inspectors, an expediter, two men in charge of architectural plans and one in charge of tenant changes report to the assistant superintendent, who acts under the immediate direction of the superintendent. Heading other divisions which report through the assistant superintendent to the superintendent are the chief engineer, cost engineer, mechanical engineer, auditor, and head watchman. Under each of these heads are subordinates charged with individual responsibilities.

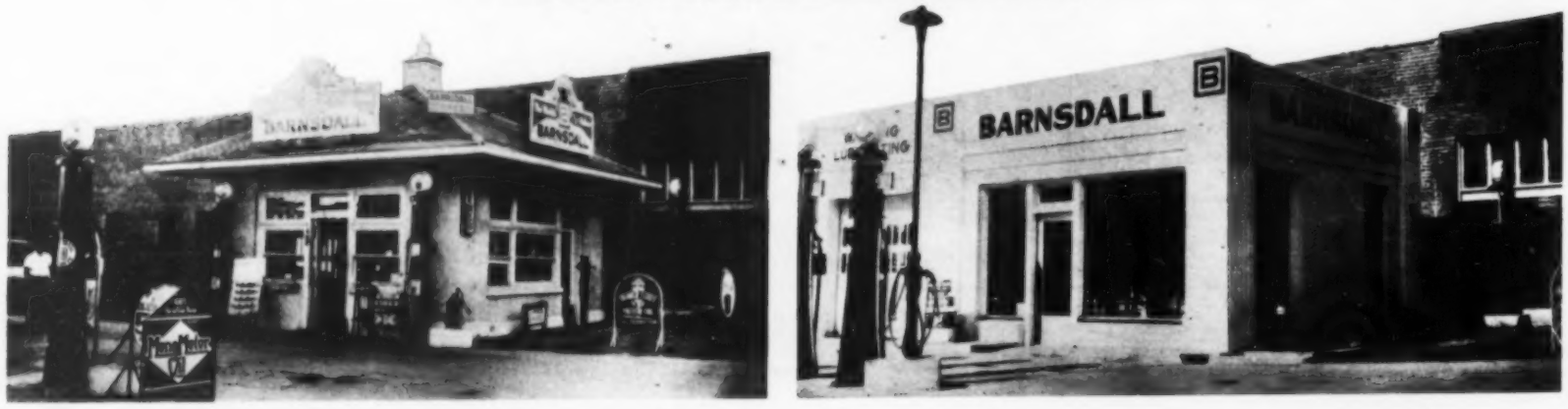
Personnel—John Lowry is president of John Lowry, Inc., W. C. Bradbury is vice-president, and S. C. Ketcham is treasurer. The plotting of predicted progress for each project has been determined largely by George M. Croll, superintendent, who has directed construction on all the firm's contracts in Rockefeller Center. These contracts have been executed under the supervision of Todd, Robertson, Todd Engineering Corp., and Todd & Brown, Inc., managing agents for the owner, Rockefeller Center, Inc., with Ernest L. Smith as project manager.

BUILDING MODERNIZATION

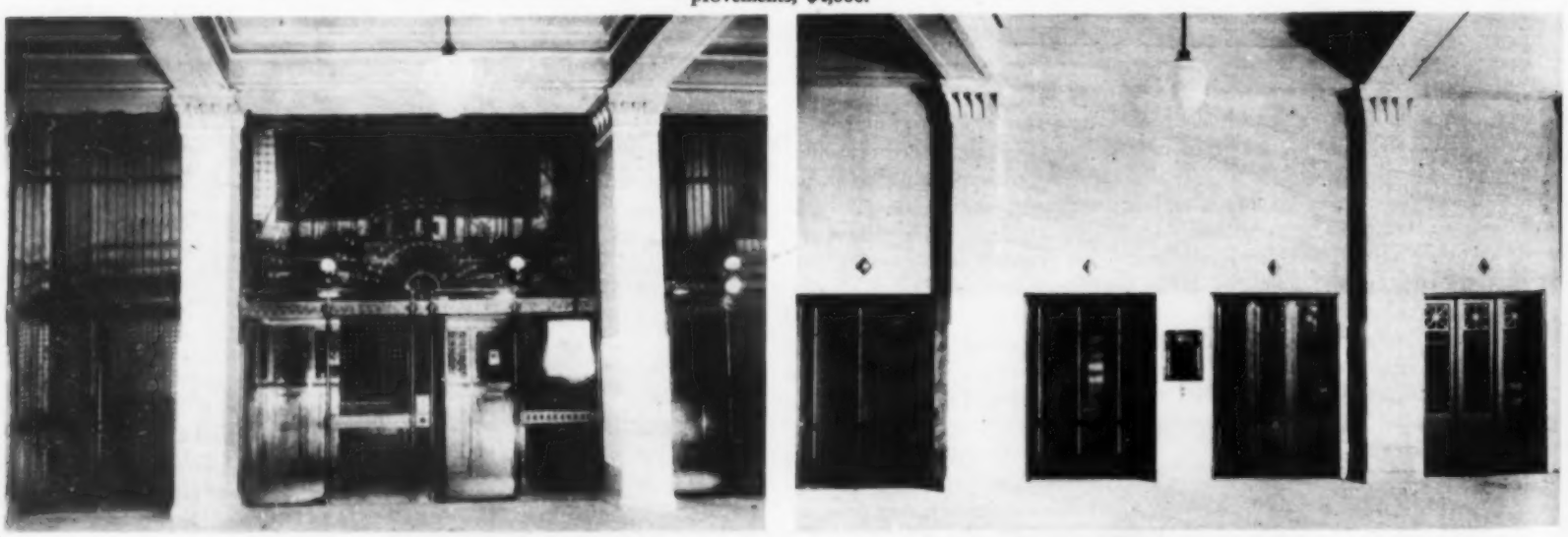
As Applied to Three Types of Structure

BEFORE **AFTER**

LUMBER WAREHOUSE. Unfinished portion of structure occupied by St. Louis Lumber Co. *(left)* is remodeled into attractive show room and sales office *(right)* with tempered Presdwood floor, wainscot, counters and circular seat. Masonite insulation is employed as finish on side walls and ceiling.



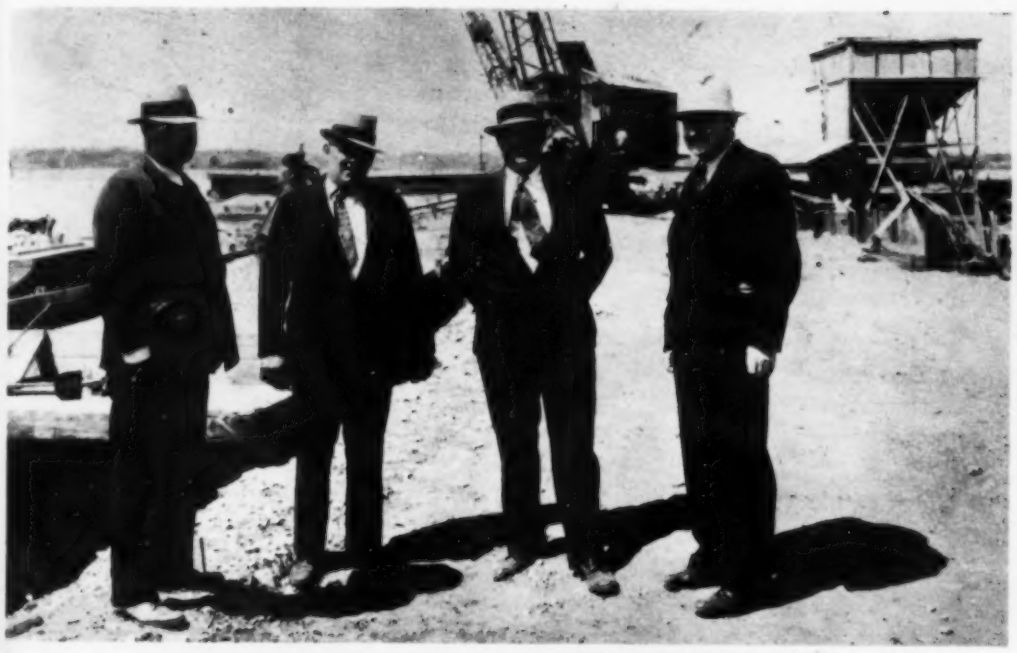
GASOLINE SERVICE STATION. Cross Construction Co., of Tulsa, converts old filling station in Claremore, Okla., *(left)* into modern, light, well-equipped structure, with new wash and grease room, *(right)* and new concrete driveway and approaches. Flood lights set flush with driveway illuminate station at night and attract business. Total cost of improvements, $4,000.



OFFICE BUILDING. Fire hazard in Trust Company of Georgia Building, in Atlanta, is eliminated and service improved by replacing old open-grillwork elevator installation *(left)* with new enclosed shafts *(right)* and substituting modern Otis micro-leveling, alternating current elevators for obsolete equipment installed in 1892. Modernization at expense of $25,000 showed savings of $5,000 in power and light for first year and 30% reduction in fire insurance cost.

Present and Accounted For —

A Page of Personalities



MISSISSIPPI DAM BUILDERS. Members of construction organization which is completing $2,195,000 contract for dam No. 20 on Mississippi River at Canton, Mo. *(Left to right)* C. J. Carpenter, secretary, and C. E. Lauver, master mechanic, of S. A. Healy Co., Inc., contractor of Detroit; Frank Haley, construction superintendent for American Bridge Co., and Louis J. Salmon, chief engineer of Healy organization.

COLORADO RIVER AQUEDUCT CHIEF. Frank E. Weymouth, as general manager and chief engineer of Metropolitan Water District of Southern California, is directing construction operations on 241-mi. aqueduct extending from site of Parker dam on Colorado River westward to terminal reservoir serving Los Angeles and group of other Southern California cities. The main line project includes 91 mi. of 16-ft. diameter tunnel, 66 mi. of canal, 56 mi. of conduit and 28 mi. of pressure pipe line, in addition to distribution system 144 mi. in length. The completed aqueduct will have capacity of about 1,000,000,000 gal. daily and will involve cost of about $220,000,000. Mr. Weymouth was formerly chief engineer of U. S. Reclamation Service.

IN CHARGE AT GRAND COULEE. Frank A. Banks, construction engineer, is directing work for U. S. Bureau of Reclamation on $63,000,000 Grand Coulee dam and power project on Columbia River in Washington.

HEADS IOWA CONTRACTORS. F. W. Parrott *(below)*, secretary of C. F. Lytle Construction Co., of Sioux City, Ia., has been elected president of Central Branch of Associated General Contractors of America. He succeeds Oscar D. Neumann, of Des Moines.

AQUEDUCTS' ASSISTANT MANAGER. J. L. Burkholder is acting as assistant general manager to Frank E. Weymouth on Metropolitan Water District's Colorado River aqueduct, with headquarters in Los Angeles, Calif. His early service on $220,000,000 water supply project was as general superintendent of construction on Coachella division, involving extensive tunneling operations. Mr. Burkholder was formerly chief engineer and general manager of Middle Rio Grande Conservancy district at Albuquerque, New Mexico.

NEW EQUIPMENT ON THE JOB

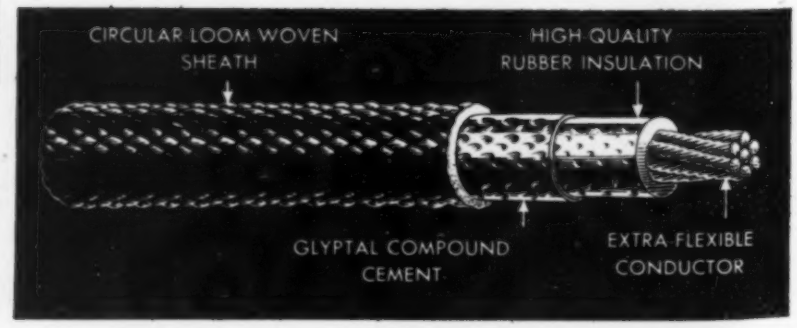
DESIGNED to do maximum amount of work with greatest attainable stability new Victor Special 1½-yd. unit is convertible to shovel, crane, dragline, back-hoe and skimmer-scoop. All operating machinery lies well back of center line of rotation, giving machine best possible balance and allowing it to lift loads with least amount of counterweight. Available with gasoline or diesel engines or single electric motor drive. Almost any combination of line speed and line pull can be provided to suit needs of job. —Osgood Co., Marion, Ohio.

DEADWEIGHT is reduced to minimum and strength is increased by all-welded construction of this dragline bucket, a general purpose unit for high production work. Bottom, sides and back are formed by single, heavy steel plate securely seamed at back and with heavy angle reinforcement mounted around entire upper edge for additional rigidity. Four forged wearing shoes, or runners, are welded to bottom to take wear from bucket shell. Arc and side reinforcements are fabricated as single unit with lip plate, the latter being 2 in. thick. — Harnischfeger Corp., Milwaukee, Wis.

HYDRAULICALLY OPERATED RIPPER *(right)* differs from other rippers in its method of lifting standards backward when cleaning. Standards make complete circle before entering ground. Fabricated largely from Continental steel. Designed for use with 35- to 50-hp. tractors.—Continental Roll & Steel Foundry Co., 332 S. Michigan Ave., Chicago, Ill.

LOOM-WOVEN SHEATH on this cable *(below)* for use on electric power shovels, mining machines, real locomotives and other heavy equipment units enables it to withstand severest mechanical abrasion with minimum of wear or breakage. Circular sheath woven like carpet is embedded in layer of Glyptal cement and in rubber insulation, this process producing cable that is tough, abrasion resisting and, because of Glyptal cement, highly resistant to oil, alkali and acid. — General Electric Co., Schenectady, N. Y.

FOR INTER-CITY HAULING of heavy and bulky loads where high speed and quick manipulation are desired, this "camel back" truck has been designed. Cab is set over engine to give maximum space for payloads and still preserve relatively short body length, thus helping to solve driver's problems where turning and parking space is at premium. Equipped with 6 wheels and 3 axles, each axle carrying one-third of load and making traction on all driving wheels equal. Rated capacity, 40,000 lb. gross. Chassis weight, 14,000 lb., cab included. Driven by 125-hp. engine at 2,500 r.p.m., torque 330 ft.-lb. All wheels equipped with 10.50x20 balloon tires, tread 70¾.—Four Wheel Drive Auto Co., Clintonville, Wis.



LOTS OF POWER, proper speed, light weight and durability—these advantages are claimed for the new Signal portable electric ½-in. standard-duty drills for general purpose work. Equipped with universal motor for a.c. or d.c. current, 110-120 v., 25-60 cycles. Length, 16½ in. Ball bearings in armature and spindle thrust. Speed, no load, 400 r.p.m. Gears, special alloy, heat-treated. Breast-plate-type handle. Trigger-type switch, with lock for continuous operation. Net weight, 14 lb.—Signal Electric Mfg. Co., Menominee, Mich.

INCREASED PRODUCTION CAPACITY by proper balancing of plant provides greater crushing, screening and conveying capacity in new model Pioneer duplex crushing, screening and loading plant. Assembly consists of primary jaw crusher with overhead eccentric, force-feed action, steel base and pitman and reversible manganese jaws with positive adjustment; secondary 40x20-in. roll crusher with manganese shells 40 in. in diameter and 20 in. wide, carried on heavy shafts, with Timken bearings; a shaker screen with 28⅔ lin. ft. of effective screening area. Return conveyor replaces bucket elevator, increasing conveying capacity.—Pioneer Gravel Equipment Mfg. Co., 1515 Central Ave., N. E., Minneapolis, Minn.

HYDRAULIC POWER CONTROL provides swift and efficient means of operating blade, leaning wheels, shifting frame on rear axle, steering and operating scarifier attachment on this new grader designed for all classes of heavy work. Strength of machine makes possible use of 23-in. blade with 90-lb. railroad rail for stiffener. Circle clearance is 35 in. and, in addition, blade can be raised 14 in. above ground. Comfort and convenience of operator have been provided for: (1) by positive hydraulic action which relieves him of all strenuous muscular effort; (2) by grouping of control valves within easy reach directly in front of his platform; (3) by one-piece frame which is but 17 in. wide and which enables him to see blade at all times.—Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, Ill.

DIESEL TRACTOR *(below)* with electric starting equipment and without excess weight incorporates three features: (1) Fuel is kept clean by series of filters, two of which operate before oil reaches pump and third between pump and injector; (2) high pressure lubricating system with rifle-drilled connecting rods (oil is forced to all engine bearings, wrist pins and valve rocker arms, thus insuring adequate lubrication to every moving part in engine); (3) smooth operation with minimum of vibration due to large bearings, rugged crankshaft and structure rigid enough to hold these parts in proper alignment. Powered by six-cylinder, solid-injection engine, bore and stroke depending on model.—The Cleveland Tractor Co., Cleveland, O.

SINGLE-TUBE PNEUMATIC TIRE for wheelbarrows permits hauling, without risk of damage, on roofing jobs and over sod or soft ground, no planking being required. Tire is similar to bicycle tire and has no inner tube, making it easy to apply and service.—B. F. Goodrich Co., Akron, Ohio.

SERVICE on Inland Reinforcing Bars Is COMPLETE

Inland Reinforcing Bars in huge viaduct over the Chicago River, Goose Island, tracks and streets —Ogden Avenue, Chicago

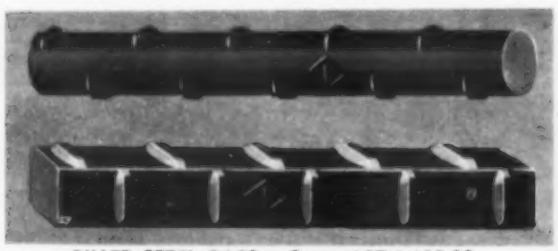
Bars furnished cut to length, bent, bundled and tagged .... also spirals, spacers, engineering service. Thus, Inland supplies the material ready for immediate use.

DEPENDABLE...

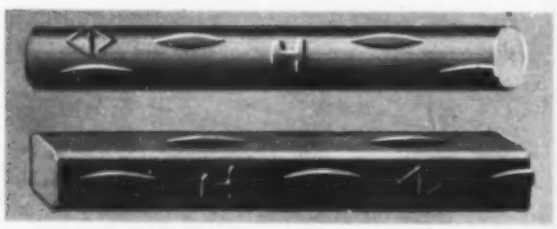
More than 40 years' experience, ample fabricating equipment and large stocks in all sizes, assure prompt and efficient service. Inland Reinforcing Bars are sold direct from our own stock and through distributors.

● World's largest reinforced concrete building — Furniture Mart, Chicago. All Inland Reinforcing Bars used.

● Below: World's largest building — Merchandise Mart, Chicago. All concrete was reinforced with Inland Bars



BILLET STEEL BARS — Spec. ASTM-A15-33



RAIL STEEL BARS — Spec. ASTM-A16-33

INLAND STEEL

Sheets Strip Tin Plate Plates Structurals Piling Rails Track Accessories Bars Rivets Billets

38 South Dearborn Street, Chicago, Illinois

GIVE 'EM THE WORKS..

On any road—on no road

On your job—on every job—on paved highways—where there are no roads at all—Goodyear Truck Tires perform better. They wear longer—more economically, because Goodyear builds truck tires specifically for each type of hauling job to be done.

For your dump trucks, Goodyear builds the Dump Truck All-Weather. It has that famous ground-gripping All-Weather tread that bites down and holds wherever your trucks go. It has an extension of the tread down the side walls for traction in soft going—for protection against cutting and scraping over sharp rocks and rough surfaces. It has a Supertwist cord body with special chemically-toughened rubber. That means strength for the heavy loads and hard pulls. It has Goodyear's new extra-strong bead construction to withstand the strains caused by heavy swaying loads on rough ground.

Goodyear Dump Truck All-Weathers are built to do the kind of work your dump trucks do. They'll do it better—more economically. Let them prove to you they're MONEY SAVERS.

THE GOODYEAR TIRE & RUBBER COMPANY, INC., AKRON, OHIO

CALL THIS MAN

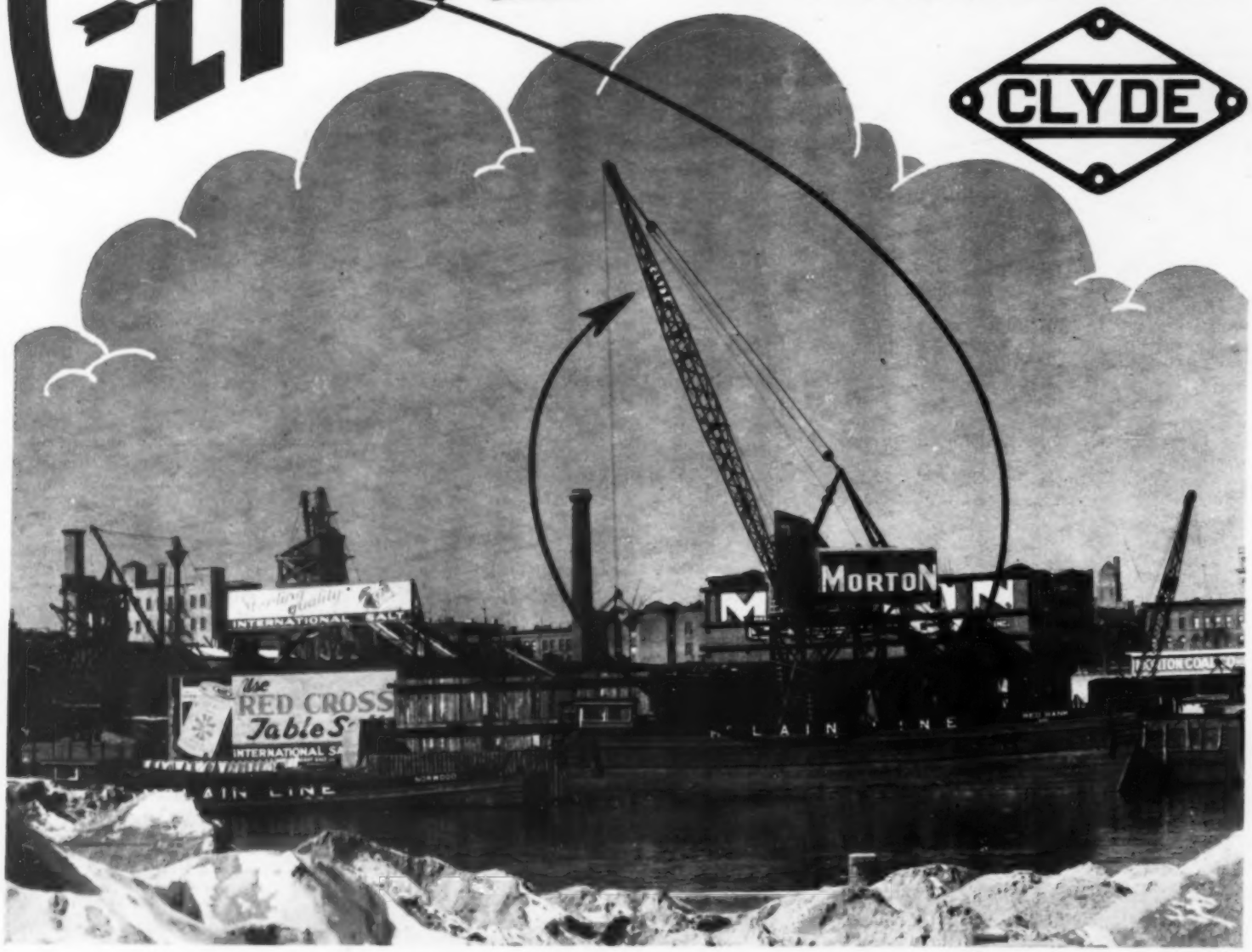
He is the Goodyear Truck Tire Man. He represents the most complete line of truck tires made. Behind him are all the years of Goodyear's experience in the design and application of truck tires for every type of business—for every job. He'll pick the RIGHT tires for your trucks. His services cost you nothing. He'll save you money.

SEE THIS TIRE

It's the famous Goodyear Dump Truck All-Weather. It's the most scientifically designed tire built for dump truck work. It represents years of experience in tire building by the world's largest builder of truck tires. It's a MONEY SAVER.

GOODYEAR TRUCK TIRES—MONEY SAVERS

CLYDE WILEY-WHIRLEY



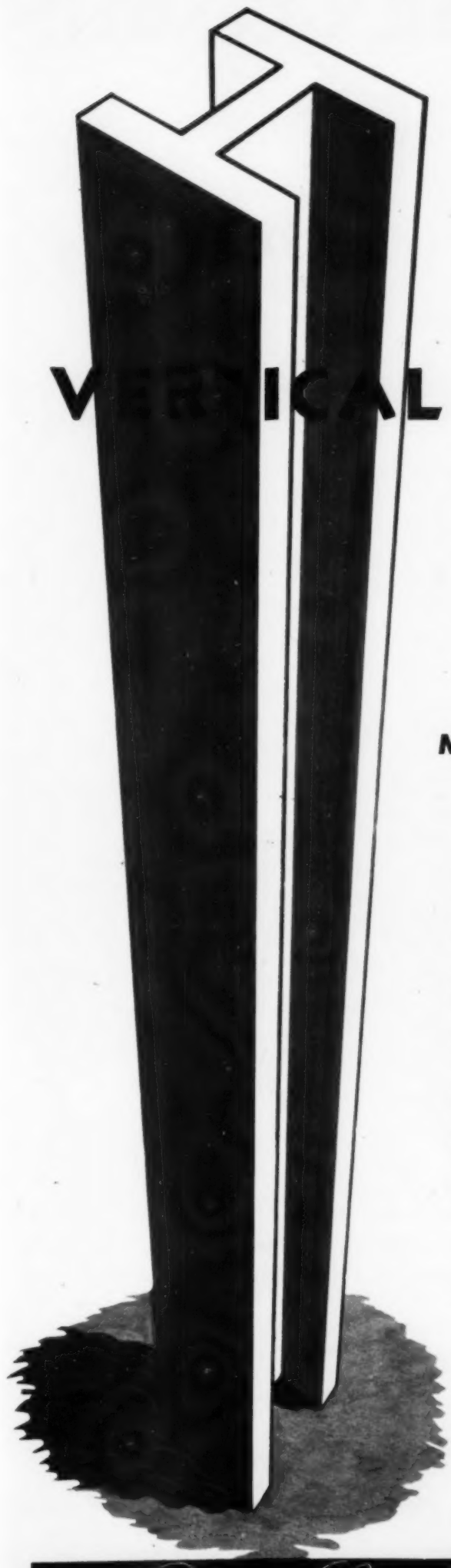
When the Morton Coal Co., New York, needed a machine for rapid and economical handling of material at their plant, they selected a Clyde Wiley-Whirley, Model 17-90, gantry mounted.

For your own special needs, investigate thoroughly the Clyde Wiley-Whirley. It is built to conform with all modern demands to meet modern conditions for handling material at industrial plants and on construction projects.

Request an interview with our representative for information and recommendations.

CLYDE SALES CO.

DULUTH, MINN.



FOR EFFICIENT VERTICAL LOAD CARRYING

GB

I SECTIONS I

May be used as combination bearing piles and columns in a wide range of applications. Particularly notable are these:

1. **Where exceptionally hard driving conditions are encountered.**
2. **Where salt water or seaboard exposure requires careful protection against weathering, or boring worms.**
3. **Where the scouring effects of stream-borne sand and rock must be guarded against.**
4. **Where heavy loads must be carried on individual piles.**
5. **Where piles must act as free standing columns of great height.**
6. **Where substantial bottoms are difficult of access.**
7. **Where the pile may be required to resist lateral forces, causing bending stresses.**

In these and in many other situations, the steel bearing pile is serving both bridge and building engineers. More complete information regarding the various sections available and their physical characteristics will be furnished upon request.

ILLINOIS STEEL COMPANY
208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS
CARNEGIE STEEL COMPANY, PITTSBURGH

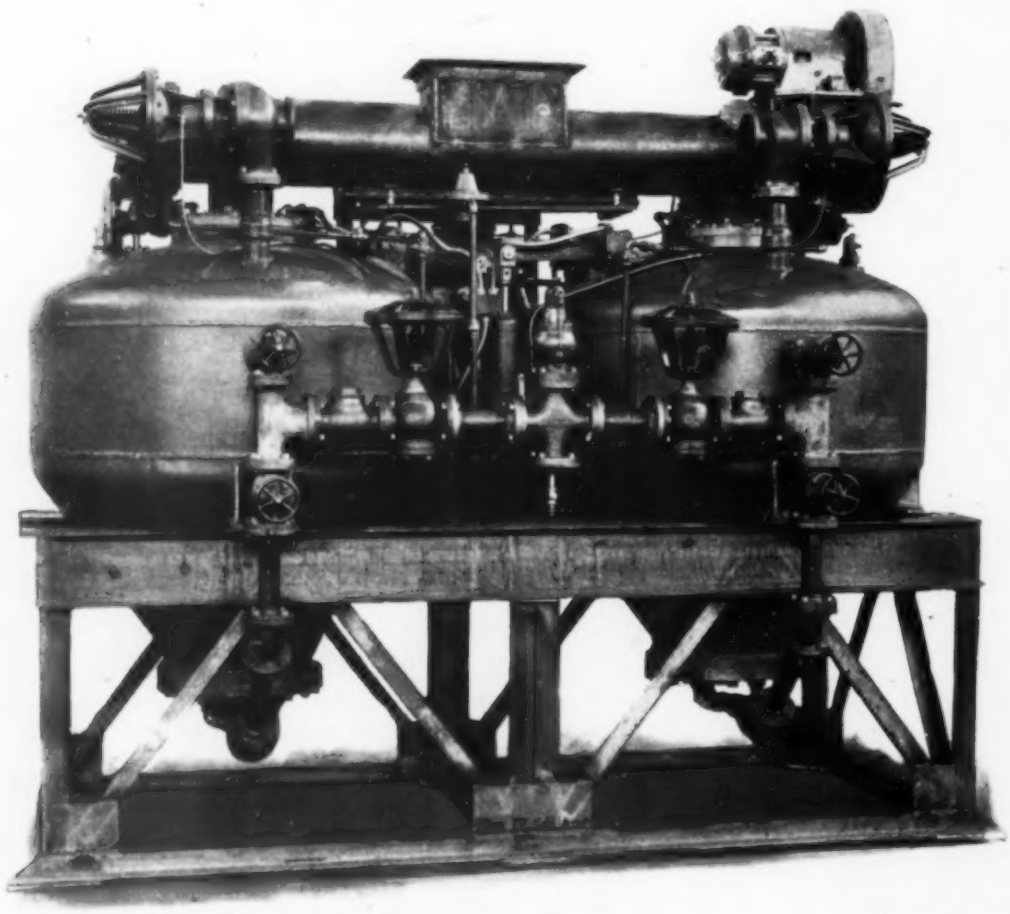
United States Steel Corporation Subsidiaries

FOR TRANSPORTING BULK CEMENT

and other pulverulent materials, pneumatically, over
short or long distances, in small or large quantities

• THE FLUXO PUMP •

At Boulder Dam, a large size Fluxo Pump has transported cement more than one mile at the rate of about 85 tons per hour; and for a distance of 200 feet with vertical lift of 130 feet, at the rate of about 250 tons (1350 barrels) per hour.



Single or double tank. Stationary or portable. Gravity or suction feed. Automatic and flexible, low power consumption, minimum attention. No operating parts in direct contact with the moving material. Economically transports cement, pulverized dry cement raw mix, dry clay, gypsum, hydrated lime, phosphates, soda ash, etc.—from grinding mills to storage—dust collected at packing machines to silos—loading and unloading silos, storage bins, blending bins, etc. The suction-feed Pump permits cheaper silo construction by elimination of tunnels and deck slab.

•

F. L. SMIDTH & CO.

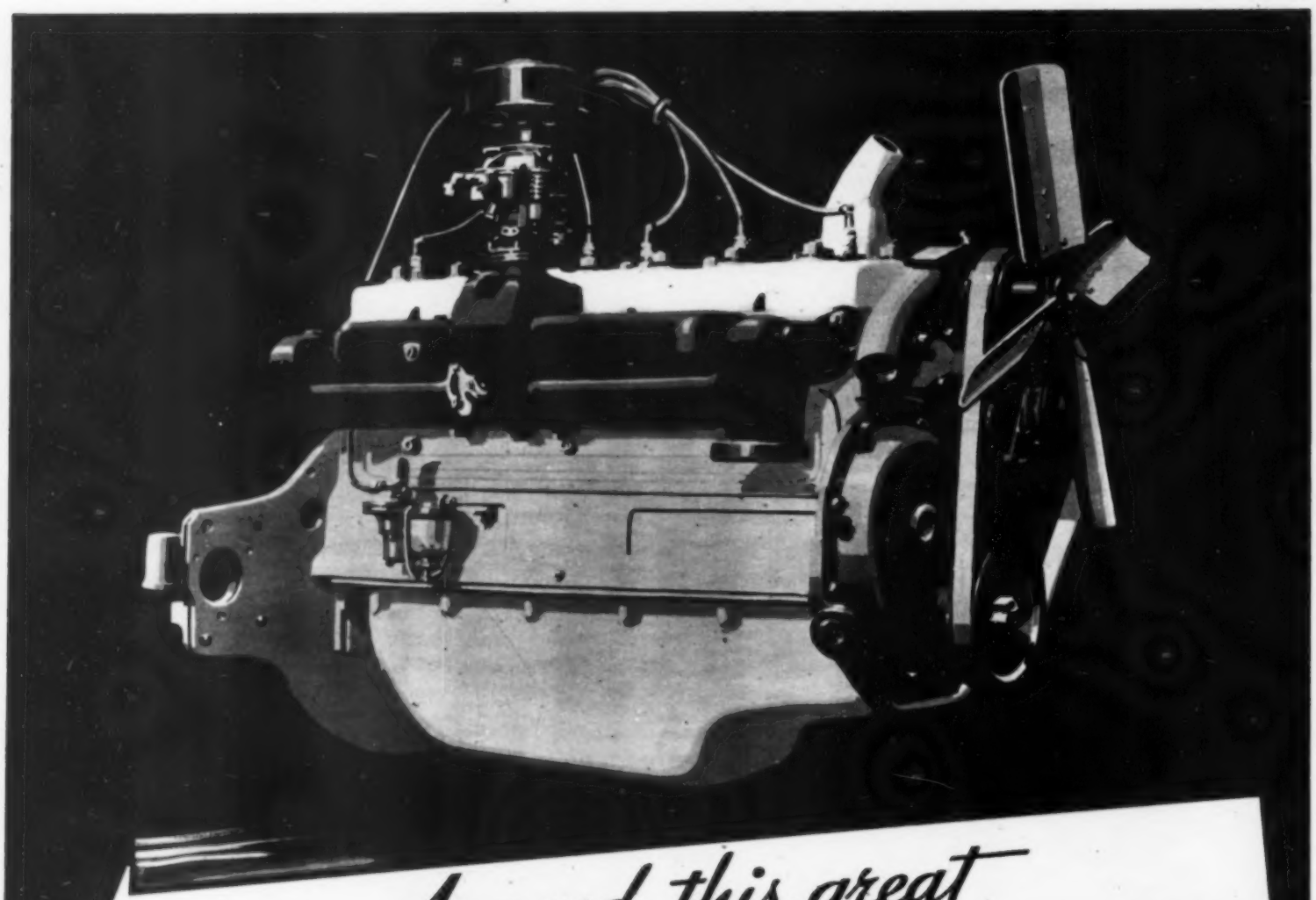
Engineer Specialists in Designing and Equipping Cement Making Factories

225 BROADWAY NEW YORK, N. Y.

Diesel LORAIN 77 & 75D

• The convincing performance of the 1½ yd. Diesel Lorain 77 may be summed up in its ability ***to increase output 10 to 20% and to reduce fuel costs 50 to 80%*** . . . but the Lorain 77 has many plus values such as proved Thew Center Drive design; modern power efficiency in the turntable; trouble-free simplicity in the crawler; greater reaches in the shovel boom . . . plus a new cable-saving fairlead . . . plus reversible, wider swing bands that more than double lining life . . . plus many other features, distinctively Lorain. They're described in the new L-77 bulletin. Write for it today!

THE THEW SHOVEL COMPANY • LORAIN, OHIO



Around this great

NEW REO SILVER CROWN ENGINE

We Have Built the Outstanding Value in the Lowest-Priced Truck Field!

No truck is better than its engine! That is why Reo engineers went straight to the heart of truck performance — created and built the sensational new 6 cylinder Reo Silver Crown Truck Engine to give a finer standard of profitable service in the lowest-priced truck field.

Here is an able, rugged *truck engine* in every sense. Maximum torque at low engine speeds — full-pressure lubrication — Lo-Ex pistons — valve-seat inserts — a husky, economical power plant specially designed and sturdily built to take the punishment of extra hard duty.

But Reo Value goes even farther. Around this great truck engine is constructed a brilliant new 1½ Ton chassis which answers the needs of 60% of all truck buyers.

Now for an investment of only a few dollars more than the lowest-priced trucks, users may benefit by Reo's 30-year reputation for longer life and lower operating costs. See this new sensationally low priced 1½ ton Speedwagon at your nearest Reo dealer today.

Reo Speedwagons and Trucks range from ½ to 4-6 tons including Tractor-Trailers and Buses. Prices from $495 up, chassis f.o.b. Lansing, plus tax. Special equipment extra.

Prices subject to change without notice.

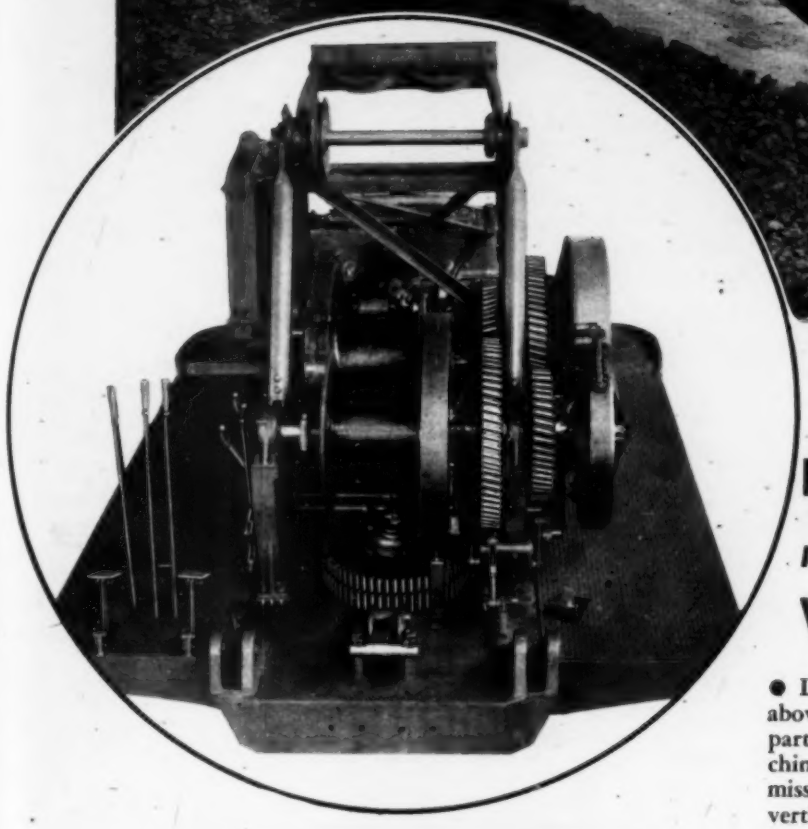
Sensationally low-priced

$535 1½-TON CHASSIS F. O. B. LANSING

TAX AND DUAL WHEELS EXTRA

REO MOTOR CAR COMPANY
LANSING, MICH.

STANDARD BODY TYPES FOR NEARLY EVERY HAULING NEED



BAY CITY *design features mean* MORE YARDAGE in WASHINGTON...

● Last fall the Bay City Model 30, standard half yard shovel illustrated above was placed in operation for the Washington State Highway Department. They have now ordered another one. A duplicate of this machine has also just been installed at Wenatchee for Chelan County Commission, adding another name to the long list of Bay City users. Convertible Bay City equipment, with standardized design incorporates the best construction features, eliminating surplus dead weight, thus adding to productive yardage and effecting lower costs.

Sturdy, tough and dependable, yet never extreme, Bay City design offers economy of operation and upkeep. Note for instance, the machinery assembly illustrated at the left. Tandem drums with more cable surface permits straight cable lead from drums with any boom or bucket, thus avoiding undue cable wear without off-center pull. Helical cut alloy steel gears insure quiet, smooth operation and longer life. This efficient machinery arrangement and design is standard on all Bay City full-revolving models.

Before you buy your next shovel, compare Bay City construction materials, design, accessibility, speed, working ranges and safe load capacity with any machine in the same capacity or weight class. You can't beat Bay City value regardless of what you pay.

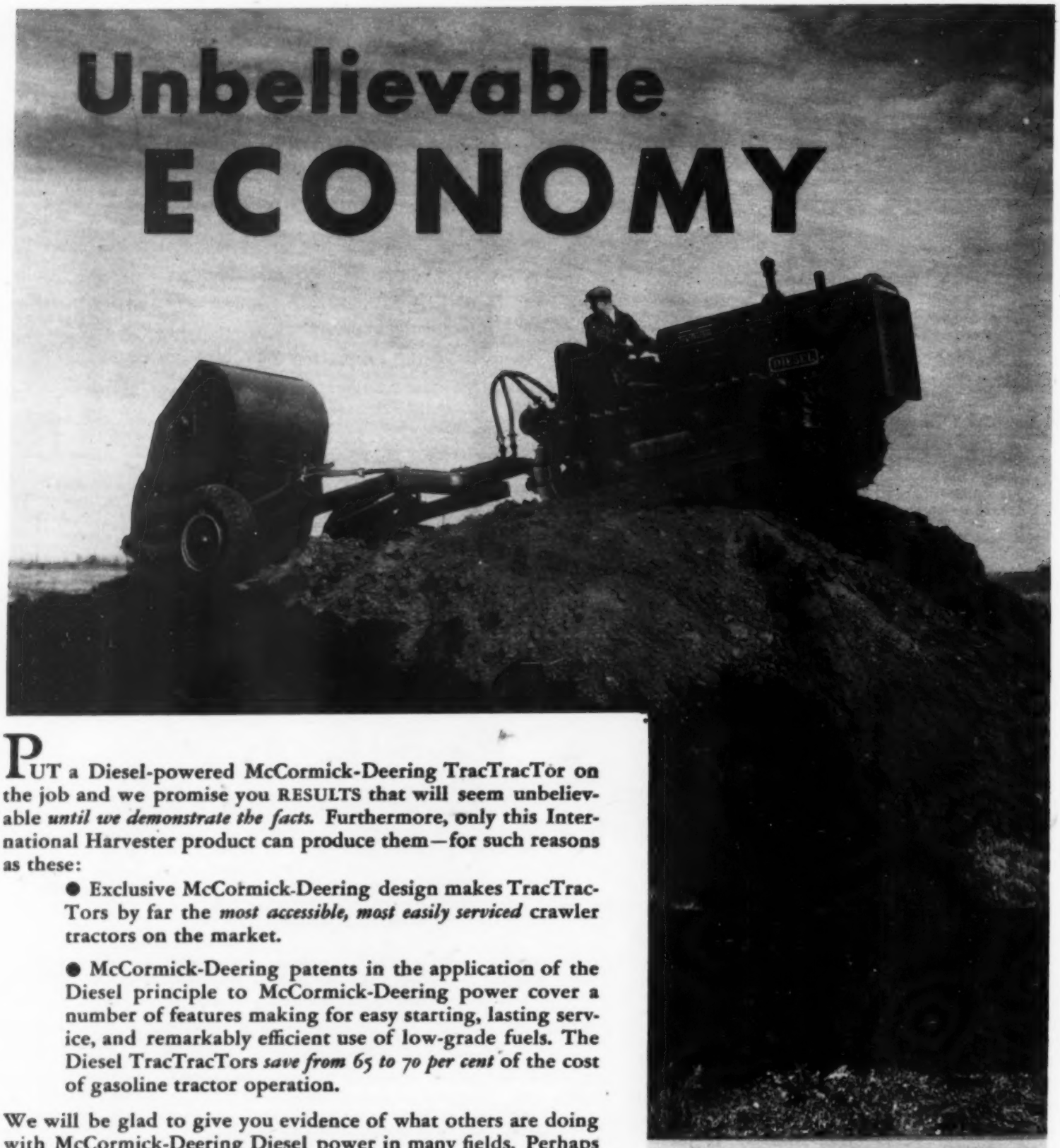
25 REASONS for CHOOSING a BAY CITY

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Frictionless bearings thruout.
5—6 cylinder power.
6—Extra large diameter swing roller-path.
7—Oversized clutches and brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible—without machinery change.
25—Accessibility for inspection or adjustment.

AVAILABLE IN 9 SIZES—⅜ TO 1¼ CU. YDS.

Model	Designation	Shovel Weight	Crane Capacity
Tractor	⅜ yd. (¾ Circle)	20,500	3 ton
27	Heavy Duty ⅜ yard	27,800	5 ton
30	Standard ½ yard	30,800	6 ton
38	Heavy Duty ½ yard	38,000	7½ ton
42	Standard ¾ yard	41,000	10 ton
52	Heavy Duty ¾ yard	52,400	12½ ton
62	Heavy Duty 1 yard	64,000	17½ ton
52-Special	1 yard	56,000	15 ton
62-Special	1¼ yard	67,000	18 ton

BAY CITY SHOVELS Inc. (Eastern Offices, Roselle, N. J.) **BAY CITY, MICH.**



PUT a Diesel-powered McCormick-Deering TracTracTor on the job and we promise you RESULTS that will seem unbelievable *until we demonstrate the facts.* Furthermore, only this International Harvester product can produce them—for such reasons as these:

- Exclusive McCormick-Deering design makes TracTracTors by far the *most accessible, most easily serviced* crawler tractors on the market.
- McCormick-Deering patents in the application of the Diesel principle to McCormick-Deering power cover a number of features making for easy starting, lasting service, and remarkably efficient use of low-grade fuels. The Diesel TracTracTors *save from 65 to 70 per cent* of the cost of gasoline tractor operation.

We will be glad to give you evidence of what others are doing with McCormick-Deering Diesel power in many fields. Perhaps the solution of your power problem is here, in the complete range of McCormick-Deering wheel and crawler tractors and stationary power units. The 30-year experience of the world's largest tractor builder is at your service. Consult the nearest of our 170 McCormick-Deering industrial power distributors or International Harvester branches, or write for information.

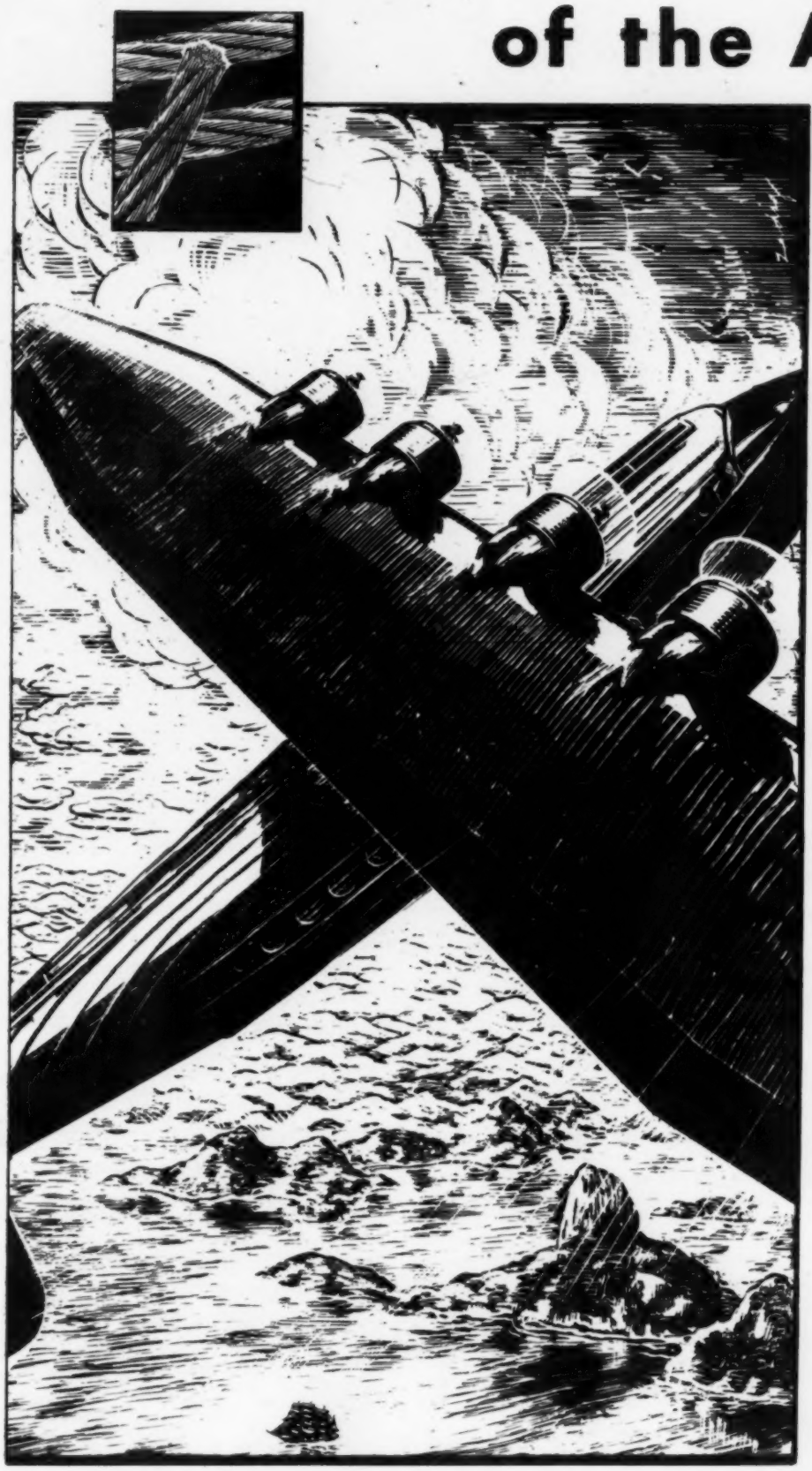
INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. *of* America (Incorporated) Chicago, Illinois

THE McCORMICK-DEERING DIESEL
starts as a regular gasoline tractor. Starts as readily as any gasoline unit of like capacity, in any weather, then switches *automatically* to Diesel operation on low-priced fuels.

McCORMICK-DEERING ACCESSIBILITY:
Steering clutches and brakes are reached through cover plates at the rear, without disturbing the tracks, track frames, or driving sprockets. Transmission and other working parts are equally accessible in the TracTracTors.

McCORMICK-DEERING DIESEL

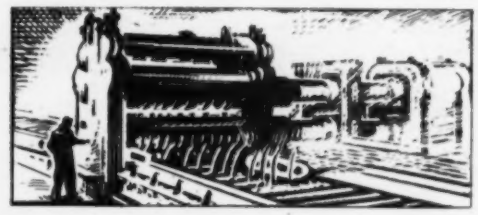
The Clipper King of the Air!



MUST HAVE CONTROL ROPE THAT IS UNFAILINGLY SAFE

Imagine a mammoth flying boat . . . carrying 32 passengers, a crew of six, over a ton of mail and express . . . and capable of flying 1250 miles without refueling. That's the "Brazilian Clipper" . . . holder of all ten world's records for transport seaplanes. It is one of three identical new Pan-American Airways' ships built by Sikorsky . . . the greatest of all trans-Atlantic type planes so far developed.

Designers selected Roebling Wire Rope for controls of all three ships. Almost a half mile of rope per ship.



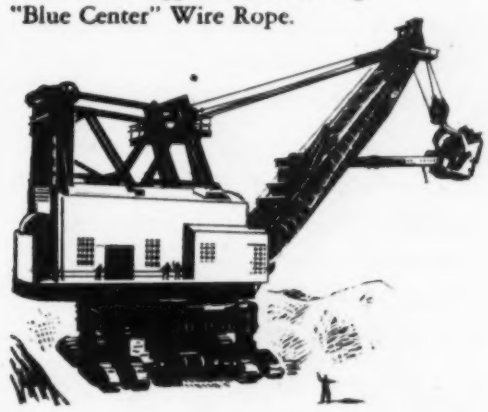
ROEBLING ROPE STEEL

It is acid open-hearth steel . . . made specifically for wire rope purposes . . . by Roebling's custom methods. Generally acknowledged to be the finest rope steel produced.

Roebling controls every process in making Roebling Wire Rope . . . from steel refining to finished product.

ONE OF THE WORLD'S LARGEST ELECTRIC SHOVELS . . .

an 18 cu. yd. "Marion", operated by Clemens Coal Co. . . . is rigged with Roebling "Blue Center" Wire Rope.



TO MAKE CERTAIN that Roebling Wire Rope will give the user the highest obtainable degree of safe, economical service, Roebling has enlisted the aid of the finest and most complete research, testing and manufacturing facilities. Roebling Equipment for making acid open-hearth steel is an example. John A. Roebling's Sons Company, Trenton, N. J. Branches in Principal Cities.

ROEBLING . . . THE PACEMAKER IN WIRE ROPE DEVELOPMENT

HOW NEW TRUCK TIRES END COSTLY ROAD DELAYS AND BREAKDOWNS

AS TOLD BY
Willard D. Jacobson
of Delmar, New York

W. D. Jacobson (standing) and James D. Jacobson of the Willard D. Jacobson and Son Company, Delmar, New York.

"Our six dump trucks are on the go most of the time hauling crushed stone. Our loads are exceptionally heavy so that it's pretty tough work for tires.

"The total mileage in the last year is well over 300,000 miles, yet we did not have a single sidewall failure or delay due to tires.

"All this means a great saving to me as now I do not have costly breakdowns on the job."

Those are the words of Mr. W. D. Jacobson. His experience has been duplicated hundreds of times since Goodrich introduced Triple Protected Silvertowns. You can save, too, with these amazing new tires.

This new invention positively checks 80% of premature failures:

1 **PLYFLEX**—a *new*, tough, sturdy rubber material with greater resistance to stretch. A layer of Plyflex in the sidewall prevents ply separation—distributes stresses—checks local weakness.

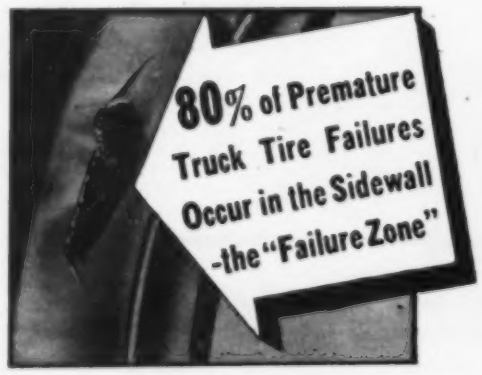
2 **PLY-LOCK**—the new Goodrich way of *locking* the plies about the bead. Anchoring them in place. Positive protection against the short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—Each cord is surrounded by rubber. With ordinary cross-woven fabric, when the cords touch each other, they rub—get hot—break. In Silvertowns, there are no cross cords. No friction.

Don't take our word for it. Try a set on a job that's really a tire-killer. Prove to your own satisfaction that Triple Protection will save you money. You don't pay one cent extra for the extra service you are bound to get.

FREE! 44-PAGE HANDBOOK FOR TRUCK OPERATORS

Every truck owner, every driver should have this big 44-page handbook. Gives commodity weights, tire load capacities, inflation schedules, dual spacing chart, load analysis and other useful information. No obligation. Write for free copy. Dept. T-39, The B. F. Goodrich Company, Akron, Ohio.



Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

THE TRUCK GMC OF VALUE

47 Reasons why it will *out-perform* and *out-earn*

***47** important quality features assure better performance and greater earnings for owners of the GMC 1½-2 ton truck.*

If you want this combination of 47 quality features that not one leading competitive truck offers, then see, inspect, test and compare the many-feature GMC 1½-2 ton that out-performs and out-earns on any sound basis of comparison.

Yes, 47 important quality features, 10 of them exclusive to the GMC among leading 1½-2 ton trucks! In fact, this many-feature truck outscores each leading competitor in many respects. Outscores them on such important counts as greater payload capacity, *latest type Lockheed hydraulic brakes with economical centrifuse brake drums and larger brake lining area*, greater horsepower, greater sustained torque and full-floating axle with straddle-mounted pinion, to cite but a few money-saving superiorities.

Before you buy any size of truck, look first to the General Motors Truck Company, the world's largest manufacturer of commercial vehicles exclusively. Whatever your hauling needs may be, there's a truck or truck-with-trailer that is correctly engineered to fit your needs exactly and haul your loads more profitably. Capacities range from 1½ to 22 tons.

For startling performance and greater economy

See the revolutionary dual performance axle now available in the 2-3 ton range. It provides a high-high gear (5.14 to 1) for fast movement on the level at economical engine speed and a low-high gear (7.15 to 1) which assures improved performance with heavy loads on hills or where the going is hard.

A Typical Value Fact

It costs more to equip the quality 1½-2 ton GMC with Drop-Forged Wheels *but they are 2 to 3 times stronger than other types. Furthermore, the rims are part of the wheels—therefore tires are always in perfect alignment, with the result that tire life is greatly lengthened.*

GENERAL MOTORS TRUCKS *and* TRAILERS

1½-22 TONS

GENERAL MOTORS TRUCK CO. Time Payments Available Through Our Own Y.M.A.C. PONTIAC, MICHIGAN

A CHRYSLER makes friends wherever the job is tough . . . .

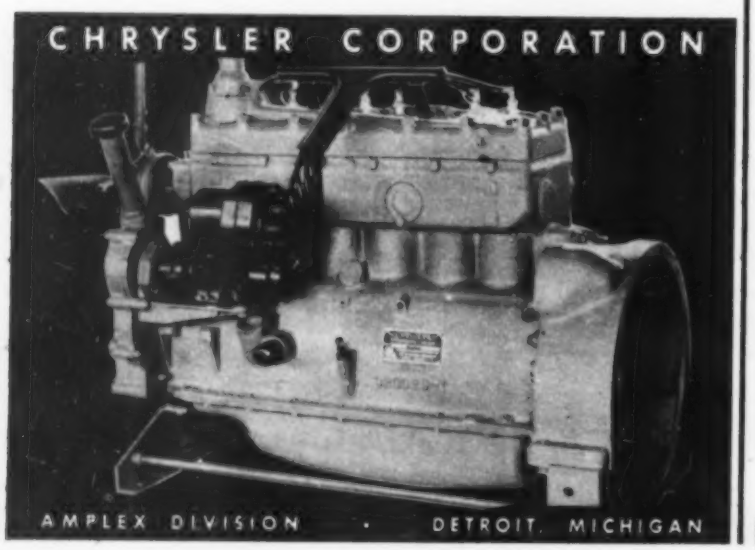
BY DOING the one thing that is demanded by experienced operators . . . more work at less cost.

Chrysler Industrial Engines are designed by leading engineers, built to precision limits. Possessing enviable records for ruggedness and long life, they cost less to buy, less to operate.

Behind every Chrysler engine are the facilities which enabled Chrysler to build more than 40,000,000 horsepower in 1934. Just imagine what that volume makes possible in experimentation and research. Think what it means in ability to buy the finest production machinery.

But, above all, think what this means to the man who buys and uses engines. It means that the cost of supplying his needs is spread over thousands of jobs . . . and he gets the savings.

We invite the opportunity to make detailed recommendations on special power problems . . . without obligation, of course.



NO PUMP WORRIES ON THE JOB!

Costly delays—sometimes unnecessary danger for your men—damage to machinery—almost anything can happen when a pump fails to function. Contractors who have turned over their dewatering to LaBour Pumps know that they can forget their worries. The extreme simplicity—only one moving part—of La Bour Self-Priming Centrifugal Pumps, means that the number of things that can go wrong are reduced to a minimum.

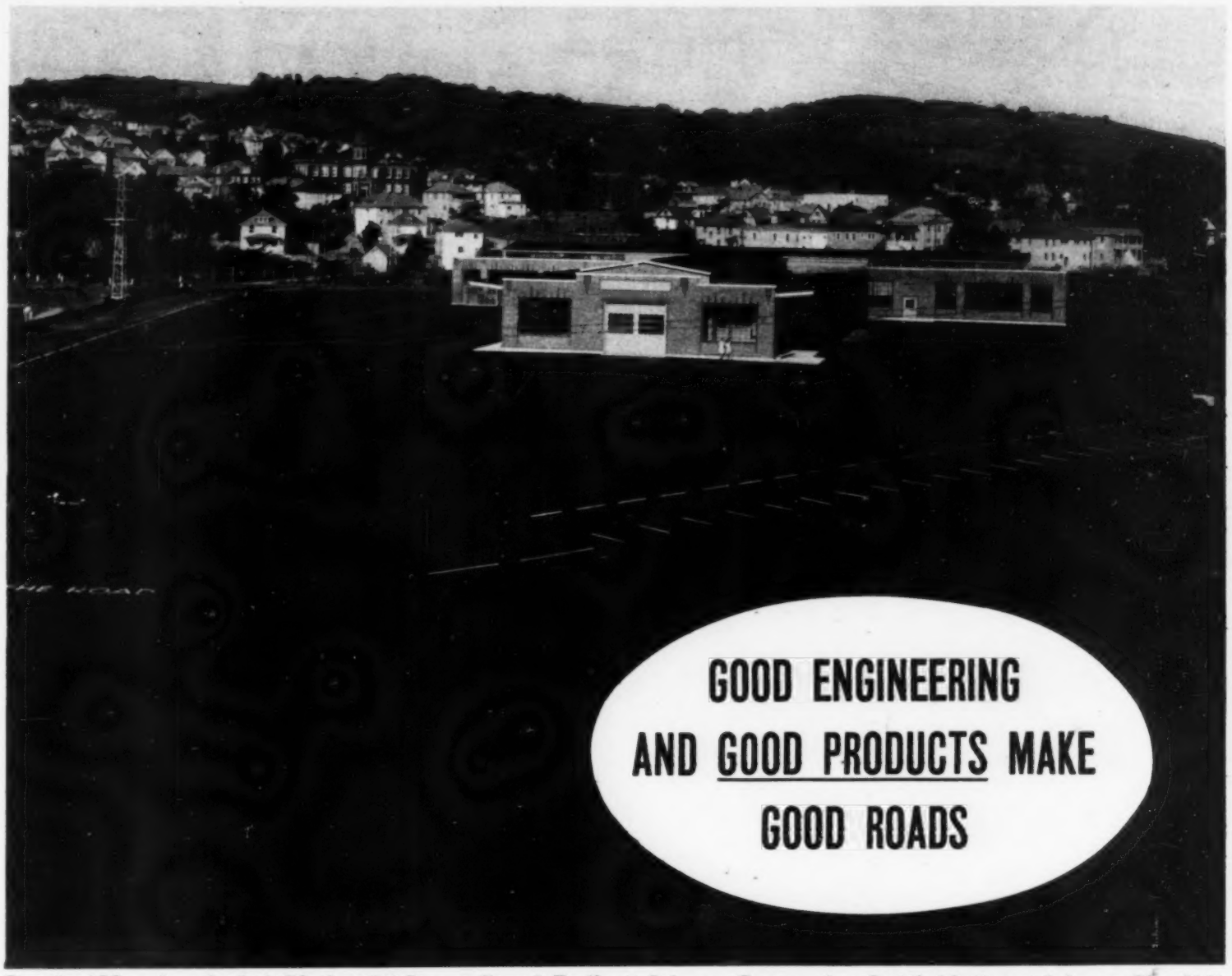
LaBour Hydrobalance Pumps have no valves to stick or become clogged. There are no springs or floats—no adjustments. Wherever they are used, LaBour Pumps are known for delivering full rated capacity even under extreme conditions of suction lift. LaBour is the only self-priming centrifugal pump which, without adjustment, does not lose capacity as the suction lift is increased when the total head remains the same.

Details about LaBour Pumps are yours for the asking. We shall be glad to explain why the LaBour patented principle, used exclusively in Hydrobalance pumps, has set such remarkable performance records on all sorts of jobs. Ask us to send a copy of Bulletin 41.

LaBour

The LaBour Company, Inc.

409 STERLING AVENUE, ELKHART, INDIANA



Standard Macadam Asphalt Binder "B" Socony Brand, Endicott Johnson Corporation, Public Market at Johnson City, N.Y.

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AND
ROAD OILS
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Standard Asphalt Road Oils
Standard Asphalt Joint Fillers
Standard Waterproofing Asphalt
Standard Cut-Back Surfacing Asphalt
Standard Asphalt Binder A for surface treatment
Standard Refined Asphalt for sheet asphalt paving
Standard Cold Patch Asphalt for all types of patching
Standard Asphalt Binders B & C for penetration work (Asphalt Macadam)
Standard Paving Asphalt 51-60 and 61-70 Penetration for the mixing method (Asphaltic Concrete)
Standard Asphalt Emulsion for Surface Treatment, Penetration, Road and Plant Mix, and Patching

Specifications and all other particulars furnished on request.

SOCONY-VACUUM OIL CO.
INCORPORATED
STANDARD OIL OF NEW YORK DIVISION

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Job Management

IN ROAD BUILDING . . . . . by J. L. Harrison

Senior Highway Engineer
U.S. Bureau of Public Roads

See J. L. Harrison's Article in This Issue of CONSTRUCTION METHODS

The series consists of six illustrated articles dealing with factors that affect equipment selection, operation and dependability, production and cost, written from the point of view of the construction superintendent.

Mr. Harrison needs no introduction to the construction field—as senior highway engineer of the United States Bureau of Public Roads, Washington, D. C., he is well known to construction men interested in all phases of highway work.

And coming at a time when the organization and proper tooling of the job assumes an importance never before reached, this represents one of the most important series of articles that it has been our pleasure to include in Construction Methods in many a long period.

Job management spells the difference between construction profits and losses in these days of keen competition for contracts. These articles, therefore, will appeal to the dollars-and-cents interest of all construction men, both engineers and contractors.

Moreover, while the series deals primarily with roadbuilding, its lessons have a broad general application throughout all kinds of construction. The same principles of organization, plant selection and operation to increase production, as are given for highway work, can be used with equal effectiveness in building a dam, erecting a bridge, or constructing a building.

Also scores of other features in every issue to aid you in saving schedule time, materials, labor, dollars.

I—DAILY COSTS:
- Interdependence of contractors' activities
- How organization affects costs
- Production per "work-dollar"
- Mechanized and hand labor operations
- Old or new machines
- Equipment set-up
- Training and supervising men

II—FACTORS GOVERNING HIGH PRODUCTION:
- Selecting rates of operation for "key" machines
- Production built around the machine
- Competent machine operators
- "Tooling" the job adequately
- "Under-tooling" in subordinate operations
- Wasting labor
- Utilizing the working day

III—EQUIPMENT DEPENDABILITY:
- Delays caused by breakdowns
- "Catching-up" lost time
- Dependability factor
- Profits and dependability
- Maintaining scheduled production rate
- "Hay-wire" outfits

IV—POWER SHOVEL GRADING OPERATIONS:
- Rate of shovel operation
- Size of dipper and "pick-up"
- Hauling equipment
- Load-carrying capacity
- Ground conditions
- Speed of vehicular movement
- Lost time
- Hauling distance

V—CONCRETE PAVEMENT CONSTRUCTIONS:
- Fine grading
- Form setting
- Mixing and placing concrete
- Mixing cycle
- Haulage
- Training laborers
- Balancing productive capacity

VI—BITUMINOUS PAVEMENT OPERATIONS:
- Rate of output
- Asphalt plant the "key" producer
- Inadequate dryer capacity
- Machine spreading and finishing
- Rolling
- Low sub-grade
- Study of weather reports
- Foresight in materials delivery
- Materials storage

Construction Methods

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SIGN AND MAIL TODAY

Would You pay 50% more for a paver which cuts your mixing time in half—and Increases Your Production 70%?

RANSOME DUAL-DRUM PAVER

Plus

1. Giving you lower operating cost per cubic yard—
2. Lower maintenance cost per cubic yard—
3. Lower cost per cubic yard of concrete.
4. A "pace maker" for entire organization—
5. Less time required to complete job.
6. A machine that enables you to bid lower.

If so, without obligation, write for Dual Drum bulletin and full information

RANSOME CONCRETE MACHINERY CO.

DUNELLEN, NEW JERSEY

Note the Rolled Shoulder as illustrated above.

SINCE 1774

THE ABW SOCKET SHANK
with Rolled Shoulder and Shock Band

FOR strength, toughness, lightness, balance and shoveling ease, this new socket shank is superior to any similar type ever produced.

Blades and shank are forged from high carbon quality steel and heat treated. It is equipped with the famous ABW Shock Band, which increases the handle strength 21%. The new rolled shoulder not only serves as a convenient and comfortable step, but gives an added strength to the blade.

This great shovel has features of proven merchandising value.

ASK YOUR JOBBER

AMES BALDWIN WYOMING CO.

Parkersburg, W. Va. North Easton, Mass.

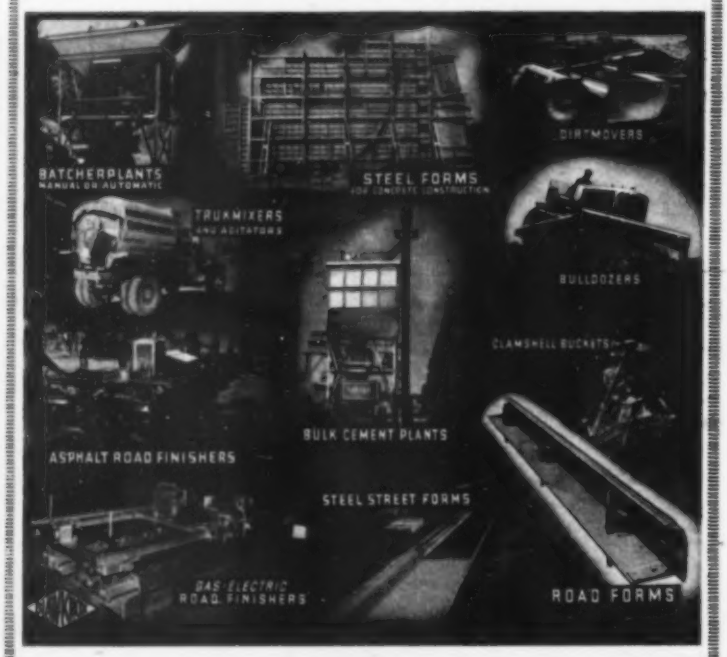
BLAW-KNOX CONSTRUCTION EQUIPMENT

MODERN EQUIPMENT—Always Kept Up to Date for Better—Faster and Cheaper Work

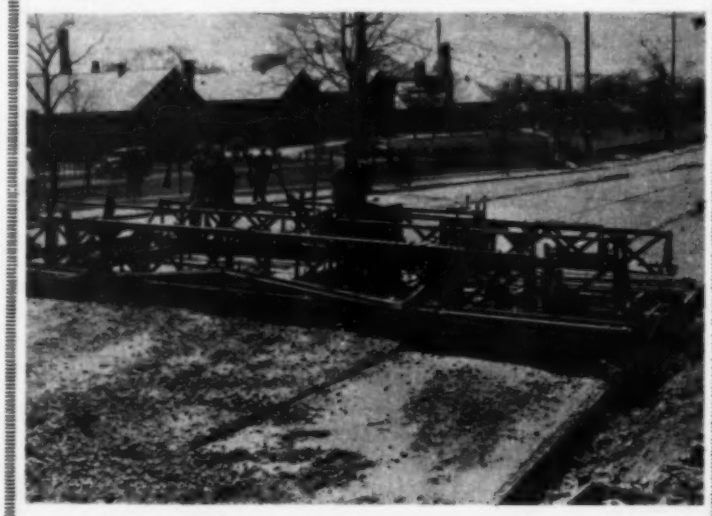
The merits of Blaw-Knox Construction Equipment are fully recognized by contractors who are able to "low bid" on competitive jobs, fulfill all specifications and end up with a reasonable profit.

BLAW-KNOX COMPANY - 2086 Farmer's Bank Building, Pittsburgh, Pa.
Offices and Representatives in Principal Cities

HEADQUARTERS FOR CONSTRUCTION EQUIPMENT SINCE 1906"



THIS MAY INTEREST YOU!



FLEX-PLANE machines will screed concrete and black top roads 3 to 50 feet wide.

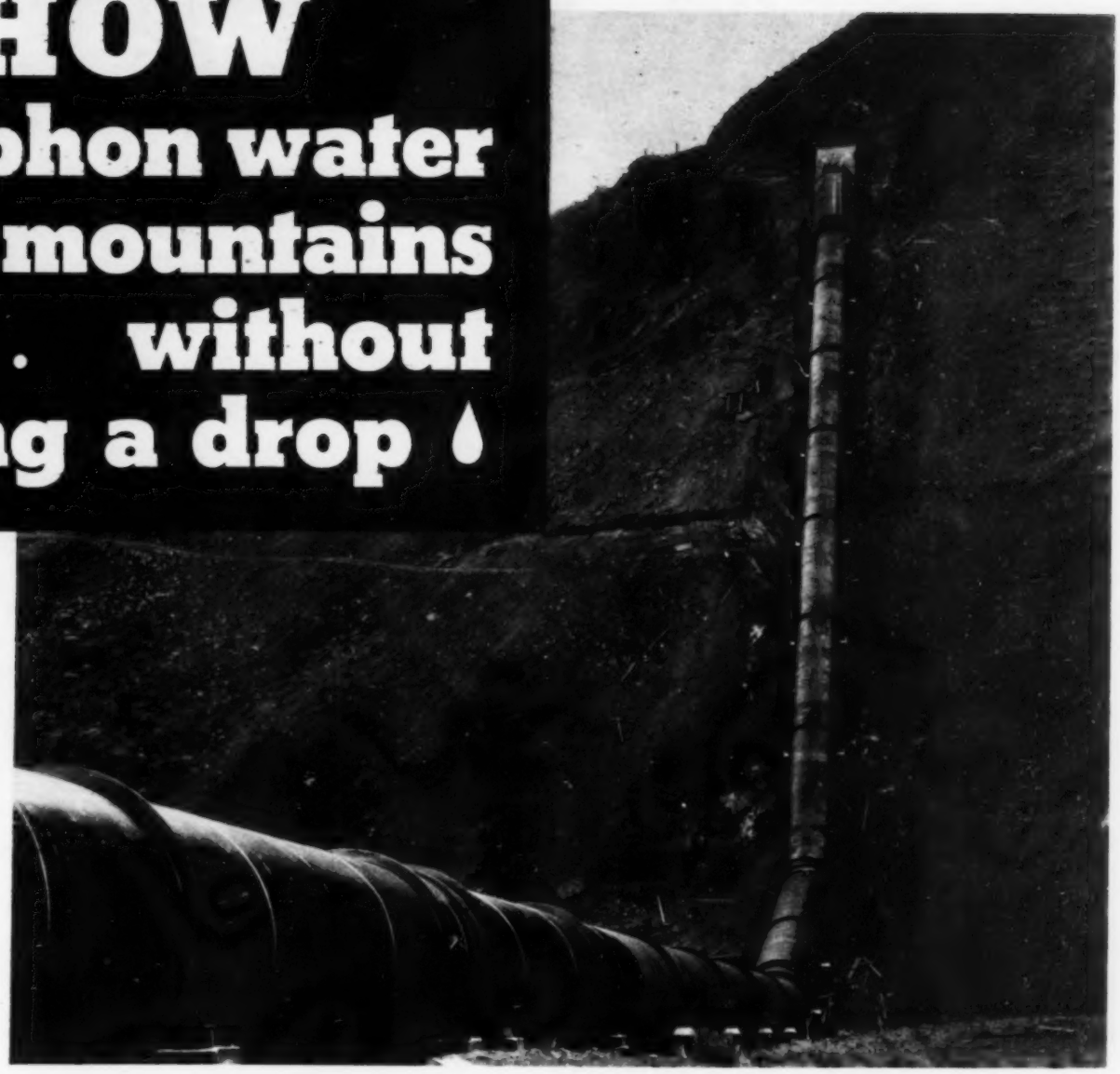
Will install contraction joints in concrete roads — both longitudinally and transversely.

FLEX-PLANE retread spreaders for spreading full width road to any depth.

FLEX-PLANE has the adjustability—the utility—the serviceability.

FLEXIBLE ROAD JOINT MACHINE CO.
Warren, Ohio

HOW to siphon water over mountains . . . without losing a drop



This 9 ft. diameter siphon, one of two on the Owyhee project, climbs a 42° slope. Field welded with "Fleetweld" electrodes by the Olson Mfg. Co., Boise, Idaho. Pipe fabricated by shielded arc welding in plant of Chicago Bridge & Iron Works, Chicago, Ill., with Lincoln equipment.

HUGE steel pipes, fabricated by automatic shielded arc welding and joined in the field by the manual shielded arc process have solved this problem, on the Owyhee project in eastern Oregon, for the Bureau of Reclamation.

Thirty days of pressure testing could reveal no leaks in the thousands of feet of shielded arc welds contained in these modern water carriers. In strength . . . in ductility . . . in density . . . and in resistance to corrosion, the welds are equal to or greater than the pipe metal. To obtain these high quality welds, it actually costs less than for any other method of welding—provided you use the Lincoln "*Shield-Arc*" welder. For it is the only machine which will allow you to get the most out of welding . . . the most in welding speed . . . the most in weld quality and the most welding per dollar.

Find out now how much better . . . how much faster . . . and how much cheaper you can weld pipe lines, or structures, with "*Shield-Arcs.*" Ask for proof from The Lincoln Electric Company, Cleveland, Ohio. Largest Manufacturers of Arc Welding Equipment in the World.

W-105

LAD "S'matter, Pop? Got ants in your pants?"

POP "I've got more trouble than putting pants on ants. Gang 3 ran out of 'Fleetweld' so they used some other kind of rod . . . now we have to chip out about thirty feet of weld metal because it does not test up to the standards set by 'Fleetweld'."

LINCOLN

"SHIELD-ARC" WELDERS

Speed Up Nut Turning
on the Contract with the
FAVORITE
Reversible Ratchet
WRENCH

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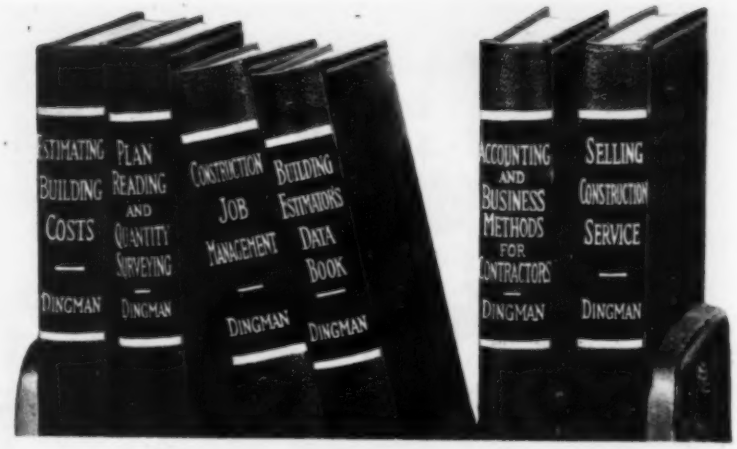

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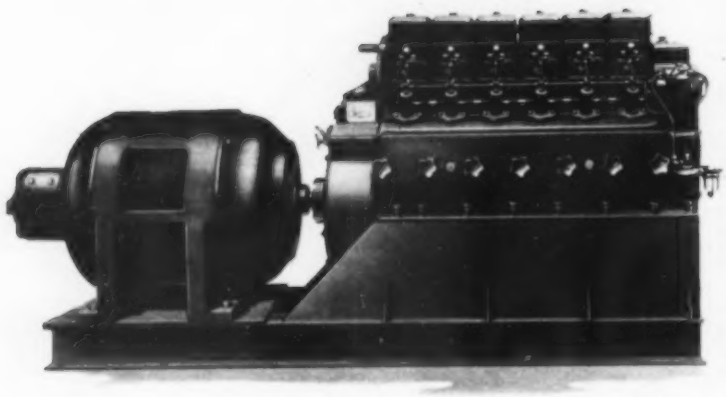

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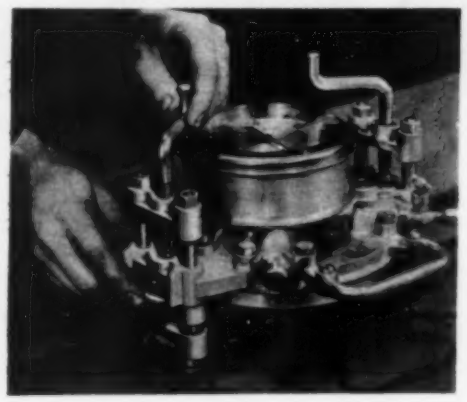

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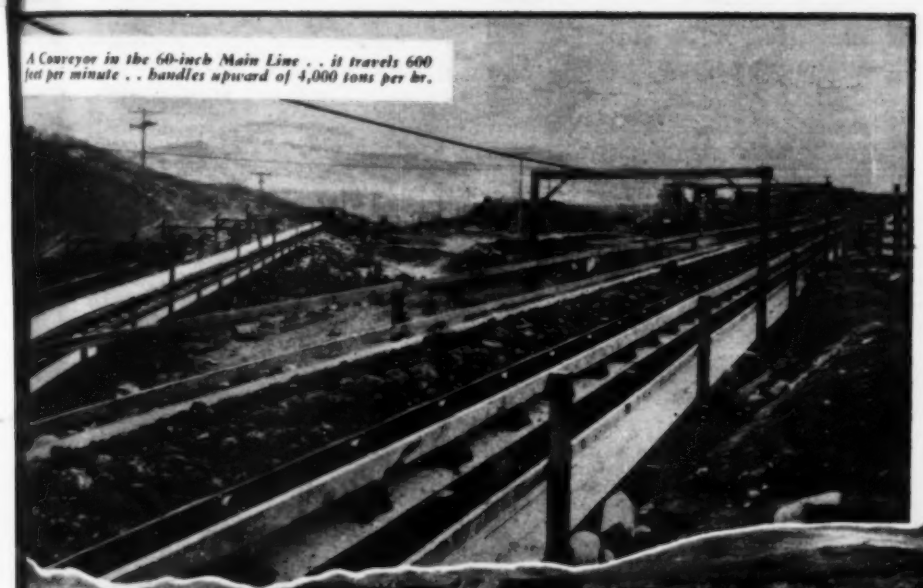

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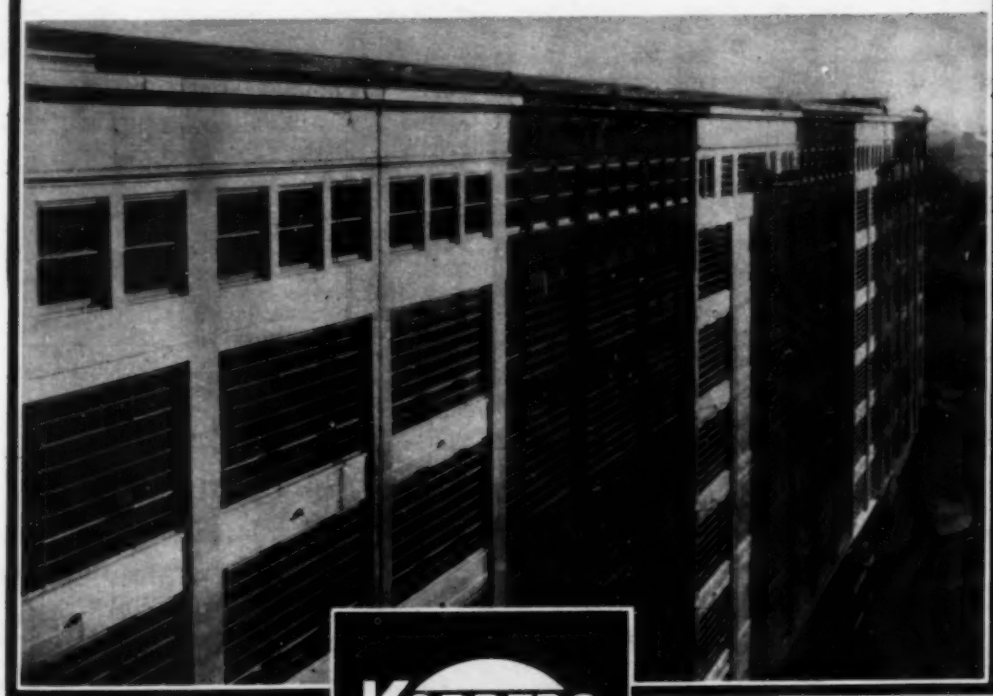
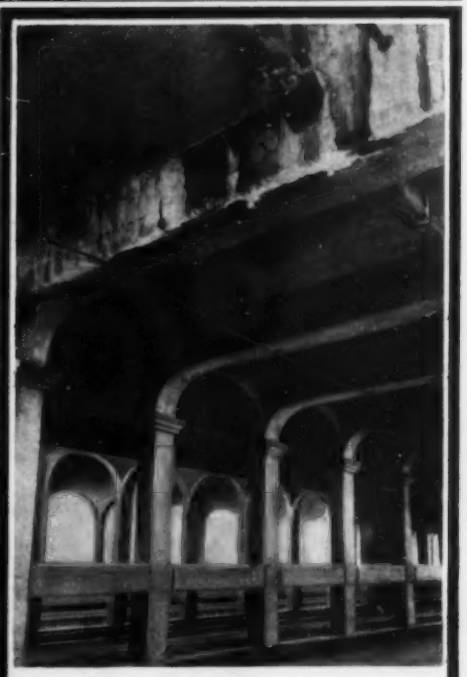
Concrete structures which are weathering may be saved from further damage with Koppers Lumino (tar-base aluminum paint). The photograph shows a large building being painted with Lumino to stop weathering.





Serious failures of concrete and masonry structures have been occurring because they were not waterproofed, or because the wrong type of waterproofing was used. The bridge shown in this photograph has been badly damaged because the waterproofing failed. Send for Sweet's reprint which tells how waterproofing should be done and why coal tar pitch prevents damage.

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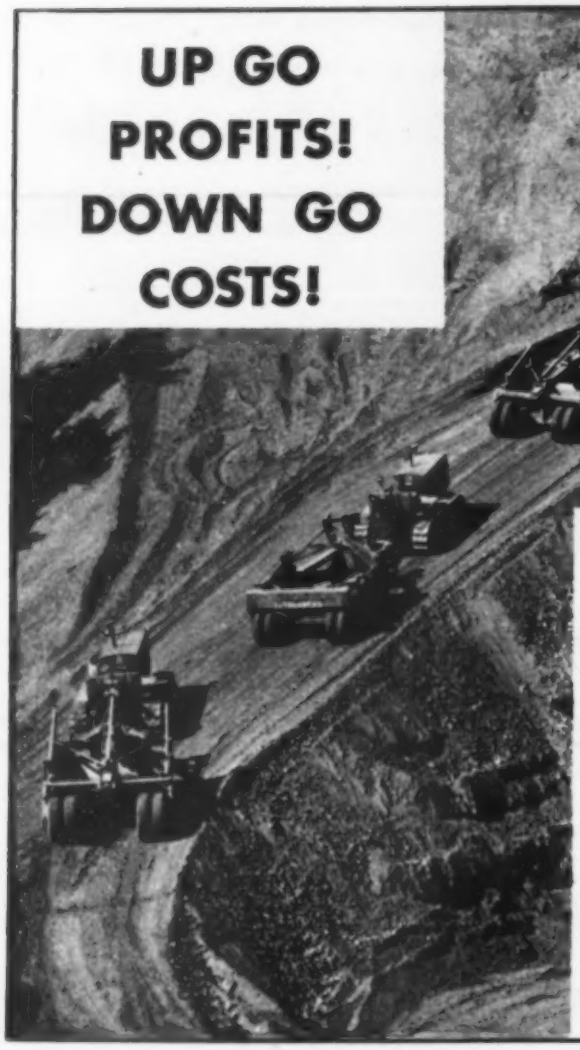

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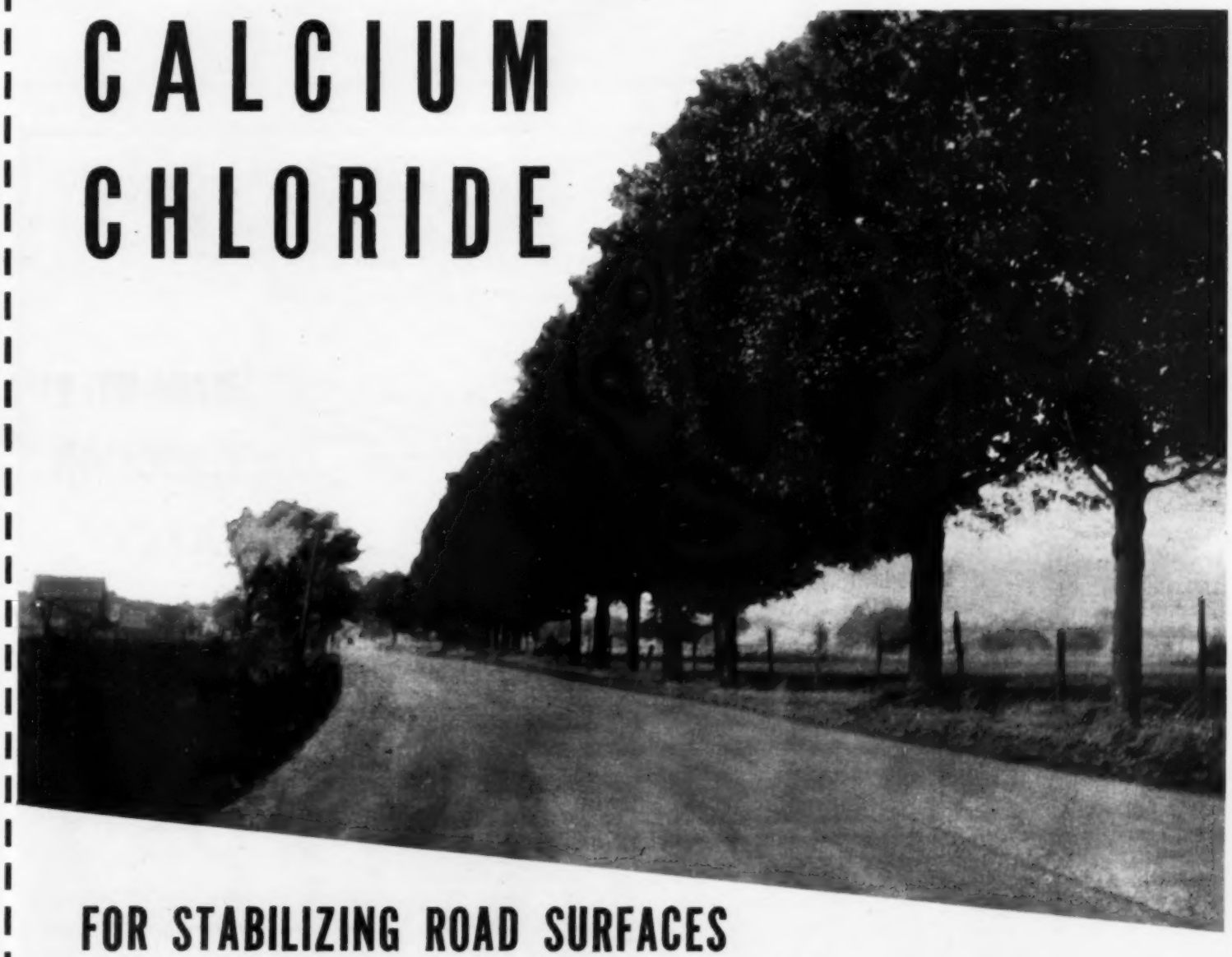

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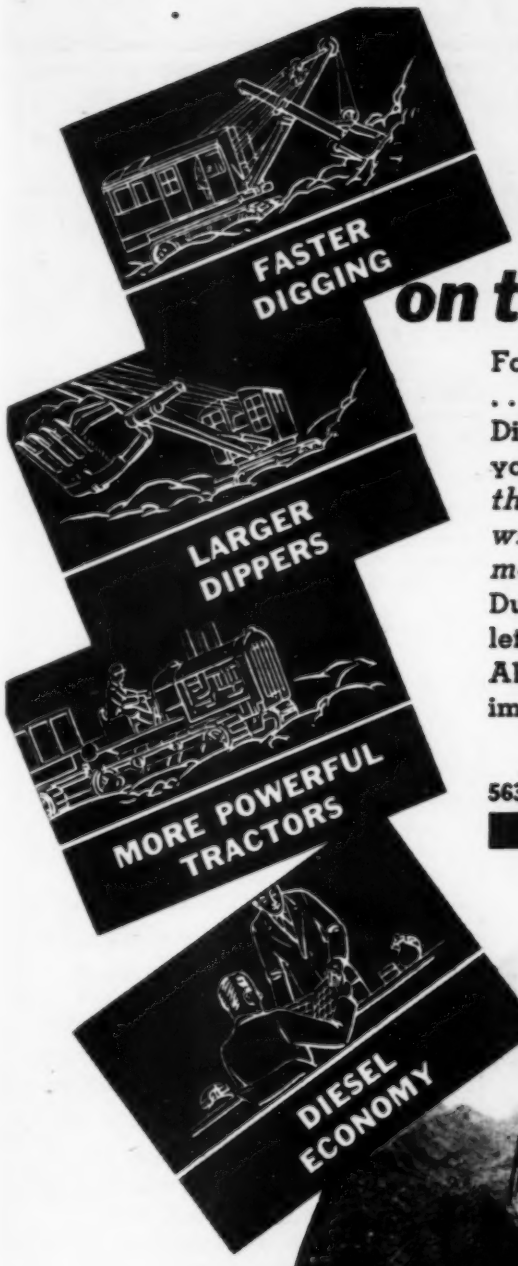

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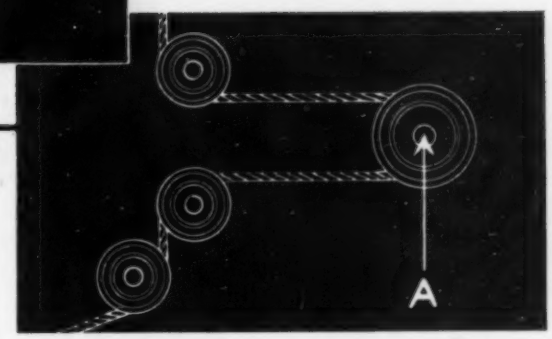

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